Energy Research and Development Division
FINAL PROJECT REPORT

# BIOFUELS AND BIODIVERSITY IN CALIFORNIA: SCENARIOS OF BIOFUEL PRODUCTION

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# PREFACE

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# ABSTRACT

The objective of this work was identifying realistic opportunities and likely locations for purpose-grown biofuel feedstock crop production in California. The analysis was limited to annual and short-lived perennial crops like alfalfa, produced on irrigated farmland within the state. Diverse, regionally-specific cropping systems were identified using 10 years of recent data on crop production from the California Department of Pesticide Regulation. Researchers applied cluster analysis techniques to this data and identified 45 distinct cropping systems throughout the state, some including up to 14 crops. They created locally specific crop budgets for each region and used them in the optimization model. As they incrementally increased prices for the biofuel crops, the model identified entry prices, acreage amounts, locations for crop adoption, and changes in water use. The study analyzed five potential energy crops, two new (canola and sweet sorghum) and three traditional (sugar beets, safflower, and bermudagrass) in the 45 regions identified. Different regions of the state were most likely to be locations for both the new and traditional crops as their relative value increases, compared to other current crops in the rotation. When relative prices are sufficiently favorable, some new crops resulted in widespread adoption and decreased overall irrigation water use. This work supports other types of analyses, including estimates of the potential effects on wildlife using cultivated regions of the state by scientists at the Bren School at the University of California Santa Barbara.

**Keywords:** California Biomass Collaborative, bioenergy, purpose-grown, energy, crop, canola, sweet sorghum, sugarbeets, safflower, bermudagrass, profit, economic, optimization, PMP, cluster analysis, adoption, cropland

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# EXECUTIVE SUMMARY

## Introduction

Environmental, economic, and political concerns about producing and using fossil fuels have led to a renewed interest in biofuels derived from dedicated energy crops or crop residues nationally and in California. To predict energy crop land cover and feedstock (raw material) production for biofuel in California, the California Biomass Collaborative developed a whole-farm economic optimization model that maximizes profits.

## Project Purpose

The model simulates current farm structure and economic conditions for farms producing annual or short-lived perennial crops (plants that survive two or more years) on irrigated land within the state, while accounting for the significant regional differences among farms. The model's primary purpose was to predict the entry price and yield at which farmers would begin to introduce new crops or crop residue harvesting for biofuels and other energy purposes, and which crop activities would be displaced based on cropping pattern economic data.

## Project Results

Phase one began with on-farm surveys to collect current production and cost data. Farmers were chosen for interviews with the help of University of California Cooperative Extension county-based extension advisers who identified participants that were representative of farmers in their regions. These were located in the Sacramento and San Joaquin Valleys and the Macarthur region (Lassen County).

In a separate study, researchers analyzed data for annual crops grown on most irrigated California cropland. They acquired ten years of crop frequency data from the California Department of Pesticide Regulation database in one-square-mile sections (640 acres). A statistical algorithm grouped the 640-acre sections into cropping pattern clusters based on crop frequencies and spatial proximity. With the unique and diverse cropping frequencies in the historical data, researchers identified 45 distinct cropping systems throughout the state, some including up to 14 crops. The current analysis phase used the resulting cropping patterns as initial conditions in the optimization model. Using historical cropping pattern acreage identified in each cluster by region, the potential for energy crop adoption can be estimated for that region. As the price or yield advantages are marginally increased and the model selects energy crops over lower valued historical crop enterprises, the change in crop cover can be reasonably estimated for the entire state. Additionally, as prices adjust, farming conditions change, or policy issues arise, current or future region-specific responses by farmers can be anticipated. These changes can affect variables such as water availability, pesticide use, and farm profitability.

Building on these two early initiatives, the current analysis used the model and the cropping pattern clusters to model energy crops on 4.9 million acres of annual and short-lived recurrent crops such as alfalfa produced on California irrigated farmland. The researchers created locally specific crop budgets for each region for the optimization model. They increased prices for the

biofuel crops incrementally and identified entry prices, acreage amounts, locations for crop adoption, and changes in water use. The study analyzed five potential energy crops, two new (canola and sweet sorghum) and three traditional (sugar beets, safflower, and Bermuda grass), in the 45 cropping pattern clusters. Different regions of the state were most likely to be locations for both the new and traditional crops as their relative value increases, compared to other current crops in the rotation. When relative prices are sufficiently favorable, some new crops resulted in widespread adoption and decreased overall irrigation water use.

The California Bioenergy Crop Adoption Model identified the most compelling shifts at the local (sub-regional) cropping pattern cluster level. While some of the clusters responded similarly to adopting the same energy crop, many of them responded quite differently. These energy crop adoption factors include cropping pattern mix, as well as the profits for each crop in the cluster, acreage allocation within the cluster, and water-use of existing crops and the incoming energy crop.

The study modeled each cropping pattern cluster over an incremental increase in profit for an energy crop. It modeled each energy crop separately, as if only one energy crop could be added to any given cropping pattern cluster. This increased profit represented the additional incentive required to move a farmer from existing cropping rotations to one that included an energy crop.

The smallest unit of economic analysis was between crops within the 45 individual cropping pattern clusters. These profit-derived impacts were then aggregated to a regional level and compared across the five established regions in the state. The third level of aggregation examined was the overall impact of the economic analysis for each cluster, summed to the state level.

The researchers incrementally increased the profit of each energy crop of interest over a range that spanned $0/acre to $40/acre in profit. At $0/acre profit the cluster operated at historical levels. At $40/acre profit, output price, yield and input costs all interacted in a way that created a relative increase of $40/acre net profit. For reference, a representative $20/acre profit increase is also reported. These $20/acre and $40/acre profit metrics are merely reference points. The market would determine the real profit when a bioenergy conversion facility entered an area and offered to pay more for the production of the energy crop than was currently being realized with the historical crop rotation.

The oilseed crops, canola and safflower, required lower amounts of water for production than the other three crops: sweet sorghum, sugarbeets, and Bermuda grass. As the profit level of these oilseed crops increased, the cumulative average water-use requirements across a cluster often decreased. In a few cases as energy crop profit approached $40/acre, the acreage of rice or tomatoes also increased. These irrigation intensive crops utilized the newly available water from lower valued crops such as cotton, oat hay, and dry edible beans, leaving the rotation for the energy crop.

As the profit and cropping activity of the other energy crops increased, the study identified other impacts. The water-use levels were constrained in the model by the existing use from historically grown crops. As the average water-use increased with increased profit levels, total

planted acreage of all crops declined. These non-oilseed crops could become profitable enough to require some cropland to be fallowed in order to realize the higher profit from energy crops that required higher levels of water than the traditional crops they replaced. Very little of either water-related effect was common below the $20/acre profit levels. These effects, both increased fallow land and decreased average water-use, were more common at the higher $40/acre profit levels.

These results were dependent on analysis conditions that included:

- Historical crop displacement in existing cultivated cropland.
- The location where the energy crops are introduced and the historical crops that are displaced in the rotation.
- All enterprise budgets adjusted to 2007 price and yield levels.

This analysis illustrated that when local resources are optimized based on local land and water-use constraints, compelling information on requisite profit levels can be established.

## Benefits to California

California currently has only a modest biofuel demand, but this is expected to increase rapidly in coming years, especially in light of recent state policies. This study benefits California by giving a statewide overview of potential economic, land and water use effects from changes in crops and farming practices to generate renewable biofuel feedstocks within the state.

# CHAPTER 1: Background

## 1.1 Purpose of this study

Environmental, economic, and political concerns about the production and use of fossil fuels have led to a renewed interest in biofuels derived from dedicated energy crops or crop residues nationally and in California (California Biomass Collaborative 2006). Executive Order S-06-06 encourages the production and use of biofuels in California. The Governor's Executive Order S-06-06 sets goals for increasing reliance on in-state production of biofuels, specifically that California should produce at least 20 percent of the biofuels consumed in the state by 2010, 40 percent by 2020, and 75% by 2050. The Low Carbon Fuel Standard mandates a reduction in the greenhouse gas intensity of transportation fuels, while federal law (EISA, 2007) sets targets for the use of Biofuels in the United States. Production of Biofuels from crops or crop residues provides an economic opportunity for some farmers, and reduces dependence on foreign oil imports.

Current annual usage of ethanol is approximately 1 billion gallons, with another 4 million gallons of biodiesel (California Biomass Collaborative 2006). California imports more than 95 percent of the biofuels used in-state (California Energy Commission 2007). The following tables indicate how those goals translate into gallons per year of production (Table 1) and estimates for area required to produce that volume if feedstocks were grown in state (Tables 2 and 3). These tables illustrate that hundreds of thousands of acres would need to be dedicated to producing biofuel feedstocks to meet even the short-term goal for 2010 at the low blend rates for both ethanol and biodiesel, increasing to millions of acres by 2050 for all blend rates. Because of differences in energy efficiencies, crop types have different land requirements. For instance, only about half the area was estimated to be needed if sugar beets were a feedstock used to meet ethanol goals compared to corn. If corn stover can be feasibly and economically converted to ethanol along with conversion of the grain, the land requirements for corn become comparable to those for sugar beets.

**Table 1: Instate biofuel production goals for several blend rate scenarios (million gallons per year). Source: California Biomass Collaborative 2006.**

| Year | Ethanol | | | Biodiesel | | | |
|---|---|---|---|---|---|---|---|
| | E5.7 | E10 | E20 | B2 | B5 | B10 | B20 |
| **2010** | 183 | 325 | 675 | 13 | 32 | 65 | 130 |
| **2020** | 390 | 700 | 1430 | 35 | 85 | 170 | 345 |
| **2050** | 900 | 1570 | 3250 | 150 | 375 | 750 | 1490 |

**Table 2: Area requirements for starch/sugar crops to meet instate ethanol production goals from in state feedstocks for several blend rate scenarios (thousand acres). Source: California Biomass Collaborative 2006.**

| Year | Corn | | | Sugar Beets | | |
|---|---|---|---|---|---|---|
| | E5.7 | E10 | E20 | E5.7 | E10 | E20 |
| 2010 | 398 | 709 | 1468 | 211 | 375 | 776 |
| 2020 | 845 | 1504 | 3116 | 447 | 795 | 1647 |
| 2050 | 1919 | 3416 | 7076 | 1015 | 1806 | 3742 |

The California Biomass Collaborative (CBC) provided initial estimates for biofuel production in California from crops and crop residues. To date, corn stover has not been successfully converted to ethanol on a commercial basis anywhere in the United States through 2010. CBC estimates for crop and residue availability were created on a coarse scale for the entire state and do not reflect diverse local farming conditions and the choices likely to be made by farmers in different California locations. Some scenarios involve the use of more land than is currently cultivated in the entire state for all purposes (Table 3), clearly an impossible outcome. The current study is focused on providing an improved, quantitative estimate of the likelihood of farmers producing crops for biofuel manufacture and the locations within the state with the greatest likelihood of this occurring.

**Table 3: Area requirements for oil seed crops to meet instate biodiesel production goals from in state feedstocks for several blend rate scenarios (thousand acres). Source: California Biomass Collaborative 2006.**

| Year | B2 | B5 | B10 | B20 |
|---|---|---|---|---|
| 2010 | 130 | 324 | 648 | 1295 |
| 2020 | 343 | 857 | 1713 | 3427 |
| 2050 | 1488 | 3719 | 7438 | **14875*** |

*exceeds existing cropland

Besides providing food, feed, fiber and now fuels, agricultural and other managed landscapes also serve other purposes. In the discussion of Biofuels from crops and crop residues, less attention has been paid to the potential effects of fuel crop production on wildlife and other natural habitats, or the use of currently managed landscapes by wildlife. Changes in cropping patterns could have both positive and negative consequences, depending on the species of concern and local, site-specific conditions. More generally, the capacity of managed (farmed) landscapes to support a range of species may be affected. The impacts may not necessarily be negative, however. For example, planting perennial crops like switchgrass on idle cropland in some parts of the United States may improve habitat quality for some species (Perlack et al. 2005). The biodiversity value of such restored lands would also increase. Some energy crop types are salt-tolerant and could help restore habitat quality by remediating high-salinity soils and associated pollution of wetlands in arid regions (Bañuelos 2006, California Biomass Collaborative 2006; Jenkins et al., 2010; Kaffka, 2010). Nearly half of the terrestrial vertebrate species in California utilize the state's agricultural lands, particularly those species with greater dispersal ability (Brosi et al. 2006). Agricultural land tends to be more valuable for feeding and

cover needs of these species than for reproduction. The continuing importance of the Central Valley as a major flyway for migratory birds, especially idled rice fields in winter, illustrates this point. Even some threatened or endangered species can persist with modest set-asides in the working landscape. For instance, the San Joaquin kit fox can survive if its prey base is maintained and there are sufficient patches of untilled land for denning sites (U. S. Fish and Wildlife Service 1998).

Demand for biofuel feedstocks may change the habitat value of existing farmland. In locations where large amounts of land are committed to the Conservation Reserve Program, some of this land may revert to annual or perennial crop production. This is not an issue in California where little CRP land is present. Some marginal or retired lands in California could become more attractive for farming however if crop prices increase or suitable feedstock alternatives are identified. Such changes may on balance reduce habitat values for a range of species. The habitat factors most likely to be altered in California's working landscapes with an increase in biofuel production include change in plant community structure (grasses, shrubs, trees), water, pesticide and fertilizer use, the introduction of invasive plant species, and timing or method of cultivation and harvesting. The conversion of rangeland to annual or short-lived perennial crop production has not occurred in recent decades in California and is unlikely under any reasonable scenario for Biofuel production in the future. Most of the consequences of using crops for biofuel feedstocks will affect those wildlife species already making use of cultivated/irrigated lands in California.

To provide a basis for estimating potential changes in habitat quality associated with farmed landscapes in California, the California Biomass Collaborative has developed a whole farm economic optimization model to predict purpose grown biofuel feedstock production and estimate crop land cover. The model simulates current farm structure and economic conditions throughout California on irrigated lands used for annual or short-lived perennial crops, and accounts for significant regional differences among farms. Its primary purpose is to predict the price and yield at which new crops or crop residue harvested for biofuels and other energy purposes enter cropping systems, and which crop activities are displaced. Land cover estimated in this way can be correlated with existing or potential uses by wildlife or provide a basis for future investigation of wildlife uses. Results were used by Dr. Frank Davis and Dr. David Stoms at the Bren School of Environmental Science and Management at UC Santa Barbara for these purposes. This report describes in detail the economic model and results from its use with five representative biofuel crops that might be grown in California in the near future.

## 1.2 Changing cropping patterns

Land devoted to crops in California is constantly changing. This report focuses on land devoted to annual crops on irrigated lands to evaluate the potential for purpose grown annual crop species being used in California as biofuel feedstocks. For annual agronomic crops, fifty years of data for principle crops: corn, rice, wheat, dry edible beans, sugarbeets, and cotton are reported. To accentuate the direction of these changes, third-order polynomial curves were fit to the acreage data to show both increases and decrease in production. These trends are not

intended to identify the cause of change, but only that acres increase and decrease in different crops. Crops change because of differing profit opportunities, the introduction of new crops or new crops to areas where it was previously thought they were unsuitable, or other changes like the development or loss of a processing facility, altering local demand. With respect to biofuel crop use, studies have been conducted in the Midwest determining that construction of an ethanol plant will raise the price of corn in that area 5.9 cents per bushel in a 150-mile radius of the plant, and up to 12.5 cents per bushel at the plant site itself (McNew and Griffith, 2005). In California, over the last decade, sugarbeet processing plants have closed in Woodland, Tracy and most recently in Mendota. This eliminated sugarbeet production in northern California where it had been profitable since 1870, due to the loss of a market for the crop. Land values or unique climate conditions influence the location of crops. Only the highest valued crops are grown on the coastal areas in part because the value of land is 4 to 5 times greater than land value in the Central Valley, and several high value vegetable crops can be grown in a single season, providing greater revenue than a single, lower valued crop. Fluctuating demand or changes in the conditions of trade for natural fibers like cotton influences the output price, as well as the competitive advantage of international sources of cotton that influence the competitive position of California cotton growers.

### 1.2.1 Crop acreage increasing

Two crops that have increased in the last fifty years in California are corn silage and rice (USDA, NASS. 2010). Figure 1 shows that corn silage has increased dramatically in the last 20 years, while acreage used for corn grain has declined. Rice acres have fluctuated over time, but since the mid-1980s, have tended to increase slowly (Figure 2). Irrigated crops, especially annual crops, have had some challenges in California in the Central Valley due to water use restrictions in recent years.

**Figure 1: Changes in California corn grain and silage acreage, 1960-2010**

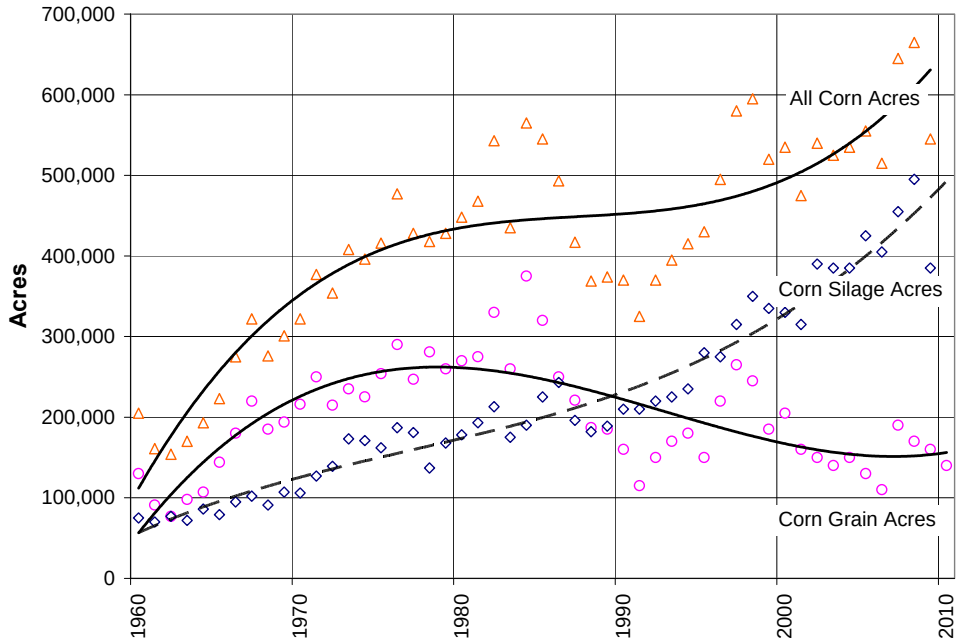
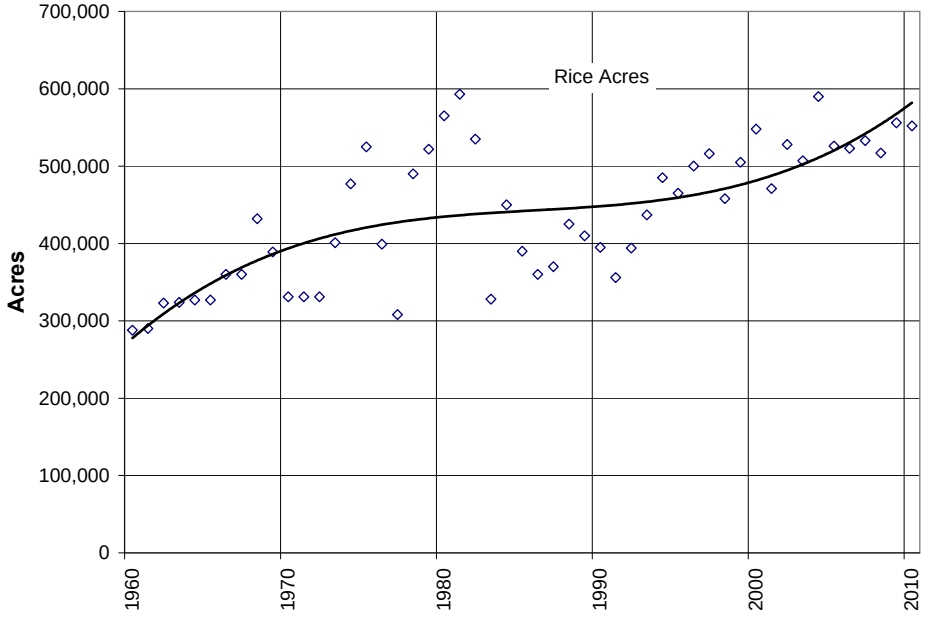


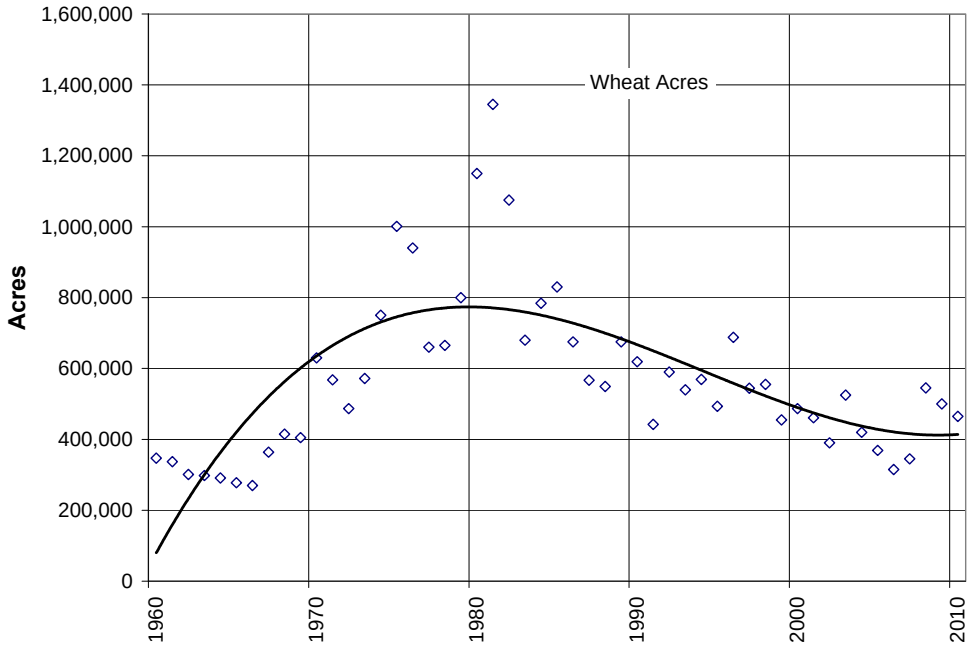

**Figure 2: Changes in California rice acreage, 1960-2010**



### 1.2.2 Crop acreage that is not increasing

A number of crop acreages are declining. Wheat acreage rose in the 1980's due to international policy disagreements with Russia, but in contrast to rice, has declined slowly since the mid-1980s (Figure 3).

**Figure 3: Changes in California wheat acreage, 1960-2010**




Dry edible bean acreage has also declined (Figure 4). In 1960, California dry edible bean acreage was over 200,000 acres annually. Since 2000, it has been below 100,000 acres, though acreage for the last three years may be lower due to irrigation restrictions. Similarly, California sugarbeet acreage has dropped from over 300,000 acres in the 1970's to approximately 25,000 acres produced for the last factory in Brawley in the Imperial Valley (Figure 5). As noted, this is due to the closure of sugar factories around the state. Upland cotton acreage is currently being produced at a fraction of the historical annual acreage. For more than 20 years, over 1 million acres of cotton were planted in California (Figure 6). Currently cotton production occurs on approximately 200,000 acres. Pima cotton has increase gradually for the last 20 years. Recent disruption of some of the international cotton production has caused the price of cotton to increase. This may shift some cotton production back to California.

Overall, all cropland acres are declining in California (USDA, NRCS. 2009) (Figure 7). More dramatic however is the shift from cultivated cropland to non-cultivated cropland. This appears is due to the shift from annual crops to perennial woody crops like vineyards, fruit and nut trees. Of the 2 million acres lost to development since 1982, 1 million acres were lost from cropland. Other land for urban development was converted from rangeland and forestland.

**Figure 4: Changes in California dry, edible bean acreage, 1960-2010**

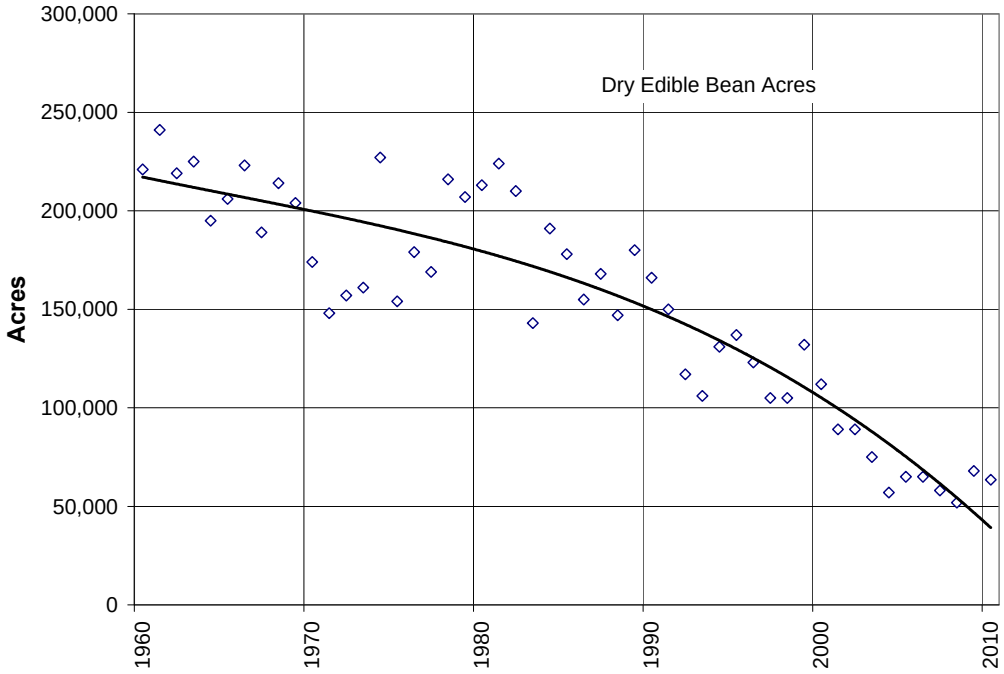



**Figure 5: Changes in California sugarbeet acreage, 1960-2010**

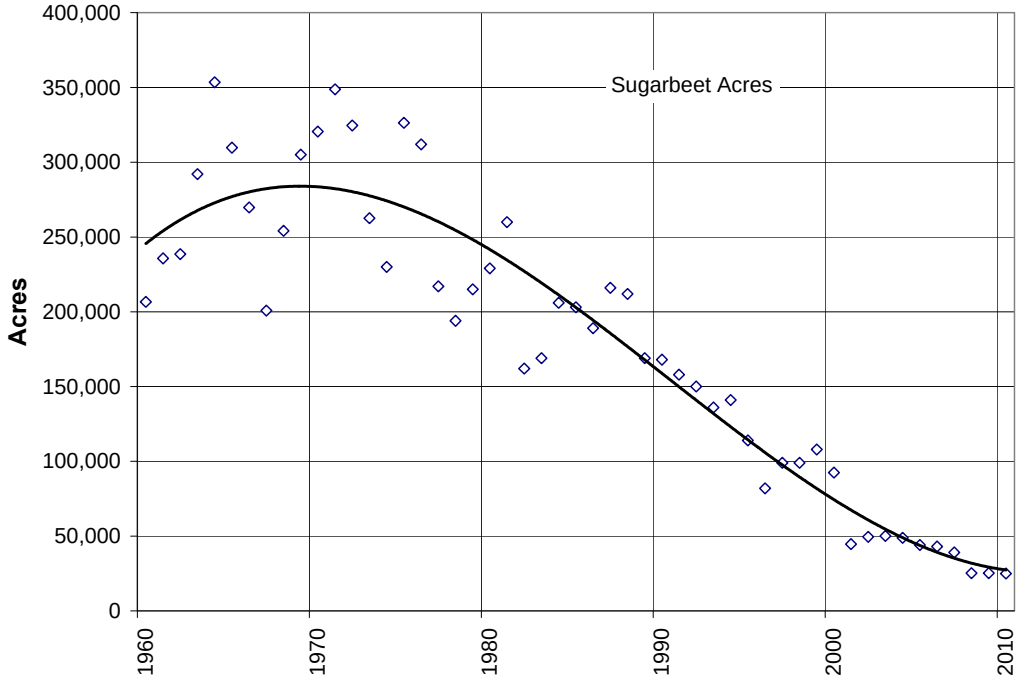


**Figure 6: Changes in California upland and pima cotton, 1960-2010**

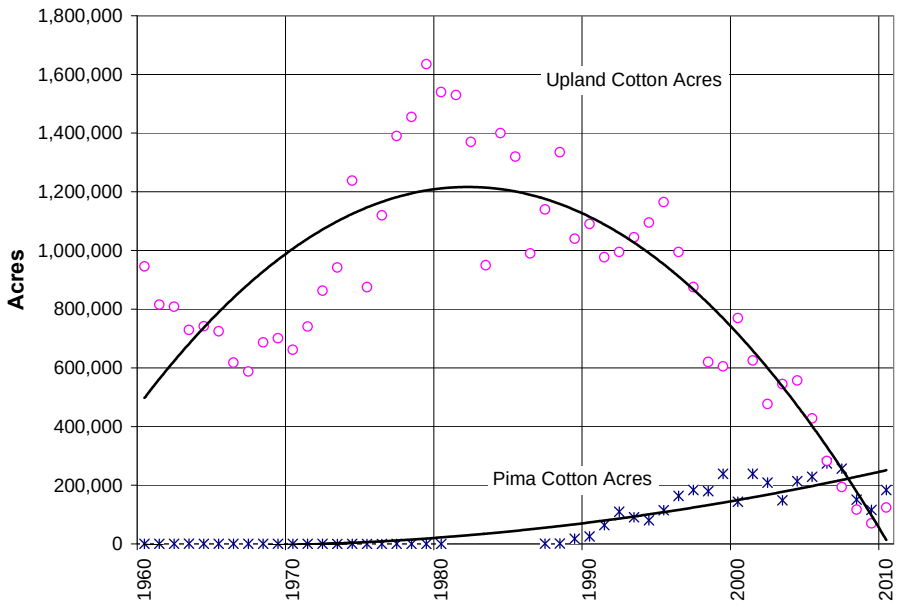
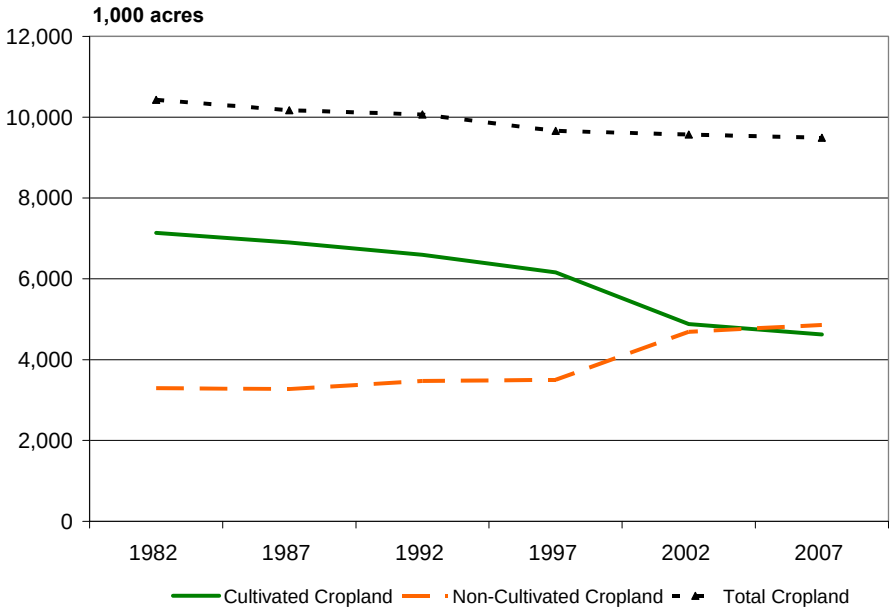



**Figure 7: Changes in California cultivated and non-cultivated cropland, 1982-2007 (USDA, NRCS, 2009)**




## 1.3 California Crop Modeling Regions

Very large amounts of section-level crop acreage data were collected and used to define representative cropping systems (see Section 2.1 below). But for the sake of discussion, results

reported here are summarized within five regions. Within each region, analysis identified larger numbers of clusters of farms with sufficient similarity in crop choice to be considered a type or a representative farm for the acres identified in each cluster. Together, there were 45 distinct cropping patterns identified in the state. But to report the results from these location-specific analyses, results were summarized. These are: Northern California (NCA), Central California (CEN), Southern San Joaquin Valley (SJV), Southern-most California (SCA), and Coastal California (COA). The basic land acreage, county and cluster statistics are summarized for the five regions in Table 4.

**Table 4: Summary of crop acres, counties and clusters in both the Census of Agriculture and the Department of Pesticide Regulation (DPR)**

| Region | model code | Crop Acres (Census of Ag) | Annual Crop Acres | Total Counties | DPR Counties | Crop/Farm Clusters |
|---|---|---|---|---|---|---|
| Northern CA | NCA | 3,190,441 | 1,538,971 | 29 | 14 | 9 |
| Central CA | CEN | 2,314,332 | 1,193,056 | 9 | 5 | 9 |
| South SJV | SSJ | 2,094,486 | 1,193,752 | 3 | 3 | 8 |
| Southern CA (IV) | SCA | 818,787 | 599,237 | 6 | 2 | 6 |
| Coastal CA | COA | 1,038,340 | 395,633 | 11 | 6 | 13 |
| Total Acreage | | 9,456,386 | 4,920,650 | | | 45 |

One of the great values of this regionally-specific, cropping system optimization analysis is the ability to capture the great variability of farming conditions and farming systems present in California. More detailed analyses are available and can be reported based on Energy Commission interest. Future analyses can report results from smaller clusters than were used in this initial analysis. For instance, the Northern California region is more accurately described as five production regions, each with their own smaller clusters of producers: the Sacramento Valley, the Delta region between the Sacramento Valley and the northern San Joaquin Valley, the Intermountain area, and the coastal region in Northwest California. In the current study, Northern California has been reduced to 9 cropping pattern clusters.

To characterize the diversity of California farms and farming regions, additional data is provided. Figure 8 compares land in farms for each region with cropland and irrigated land from the 2007 Census of Agriculture. This is a larger amount of land than was utilized in the DPR dataset because woody perennial crops and irrigated pastures were not considered in the cluster analysis. Figure 8 shows that nearly all the cropland in each region is irrigated, while the cropland is generally less than half of the land in farms in each region. This category also includes rangelands, which are not generally irrigated and grazed primarily by cattle. Figure 9 shows a distribution of farm number by region. As in Figure 8, there are a large number of irrigated farms in relationship to total farms. Figure 10 compares measure of annual value of production with land rental rates by region. In the larger production areas: NCA, CEN, and SSJ; the land rental rates are the lowest as well as the annual value of production. In the Imperial Valley region (SCA) and the Central Coastal zone land rental rates and annual value of production both increase. In the Central Coastal region, the average land rental rates are over

$1,000 per acre while the annual value of production is nearly $6,000 per acre. It is difficult with these values to produce lower-valued energy crops. Finally, Figure 11 illustrates the distribution of crop type across regions. In this analysis the two regions that are included are the vegetables, melons and potatoes, and the grains, oilseeds, and hay crops. The other two categories are not included in the DPR cropping pattern optimization.

**Figure 8: All land in farms, cropland and irrigated acres by study region**

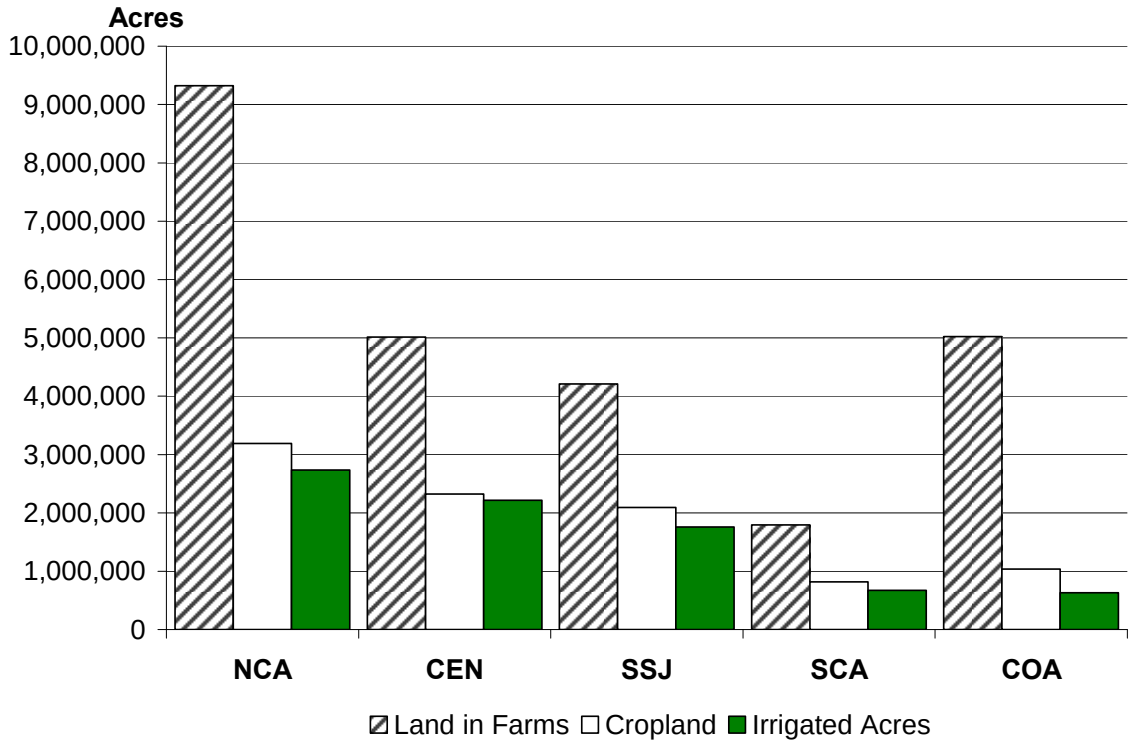


**Figure 9: Number of total farms and irrigated farms by study region**

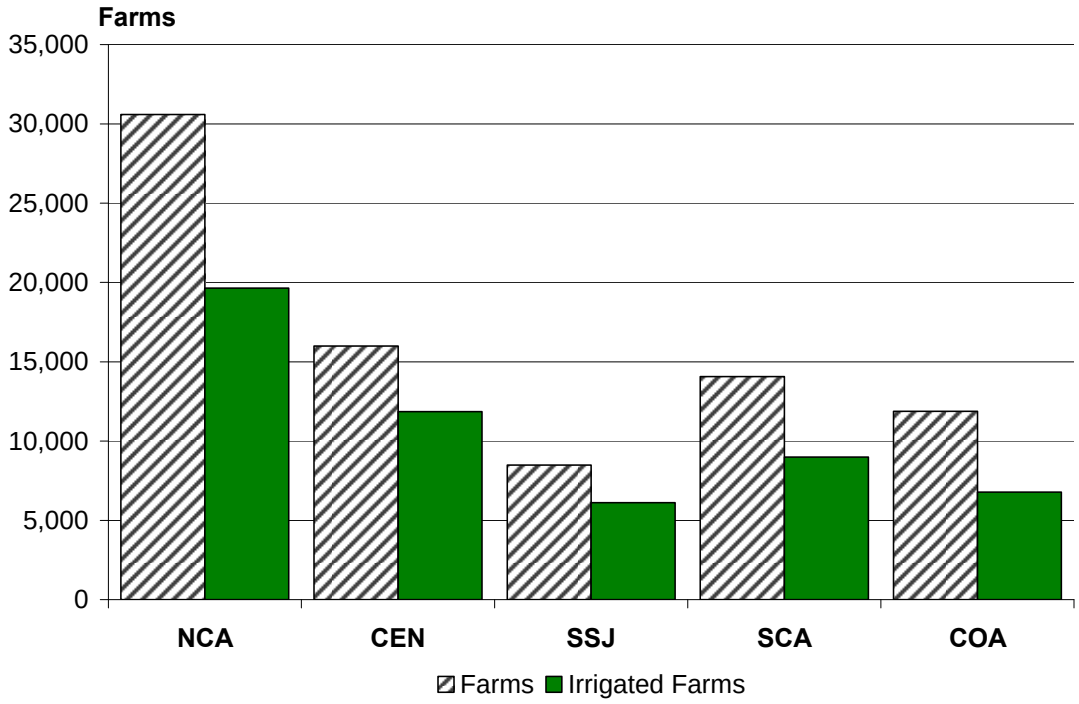



**Figure 10: Annual cropland rental rates and value of crop production/acre by study region**

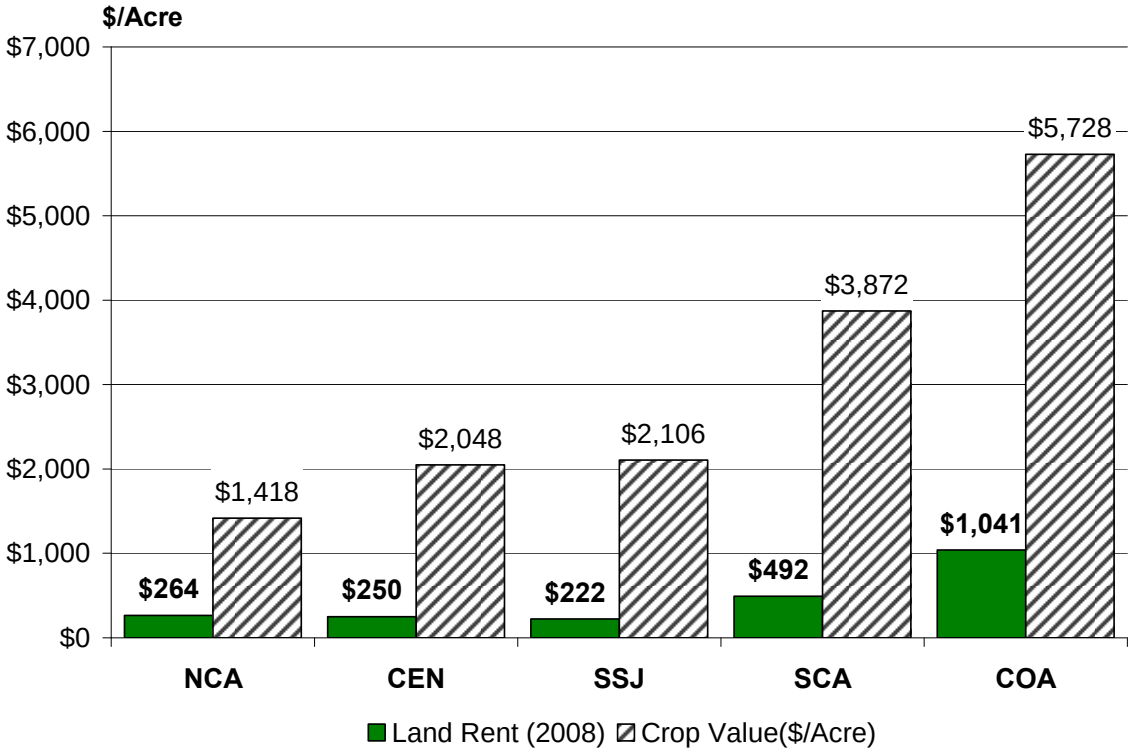
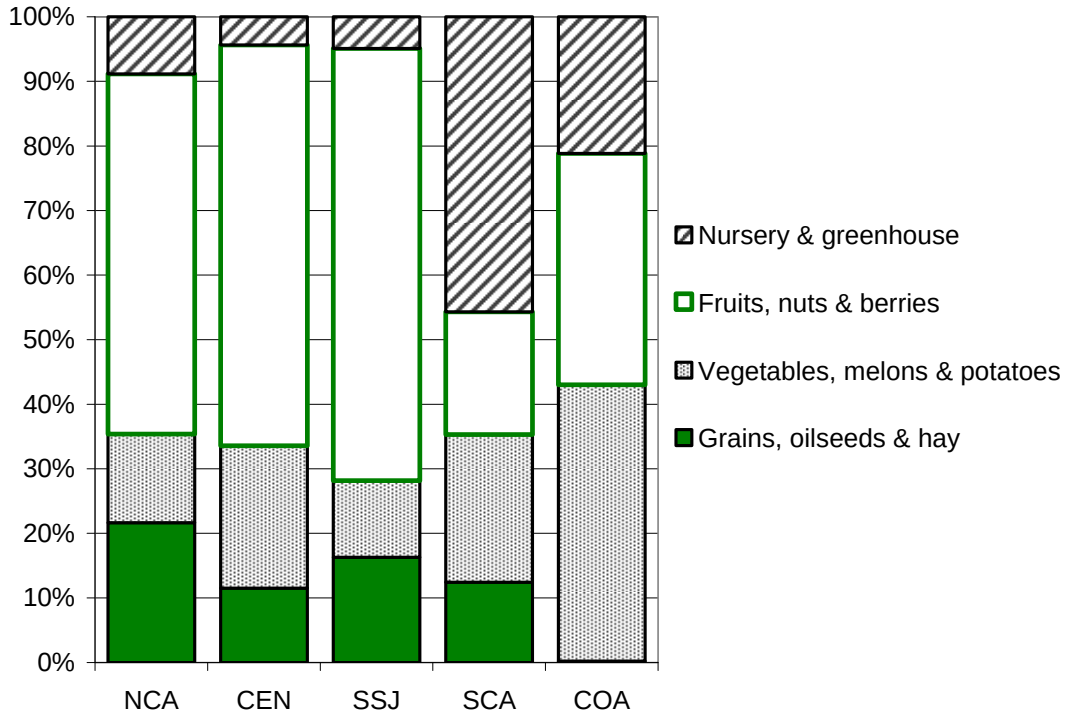


**Figure 11: Distribution of regional crops by value of production**




### 1.3.1 Northern California (NCA)

Figure 12 presents the counties included in the NCA region. It also includes the precipitation and weather data for Redding, CA and Sacramento, CA. The more northern city, Redding, has an average annual precipitation of 39.4 inches. Sacramento, in the lower part of the region, has an average annual precipitation of 17.8 inches, which is less than half of the rainfall in the northern part of the NCA region. Rainfall is sufficient to supply water for rainfed crops in the northern half of the NCA region. There is also sufficient moisture to allow production of crops with demanding water needs such as rice.

**Figure 12: Counties and rainfall for the Northern California region**

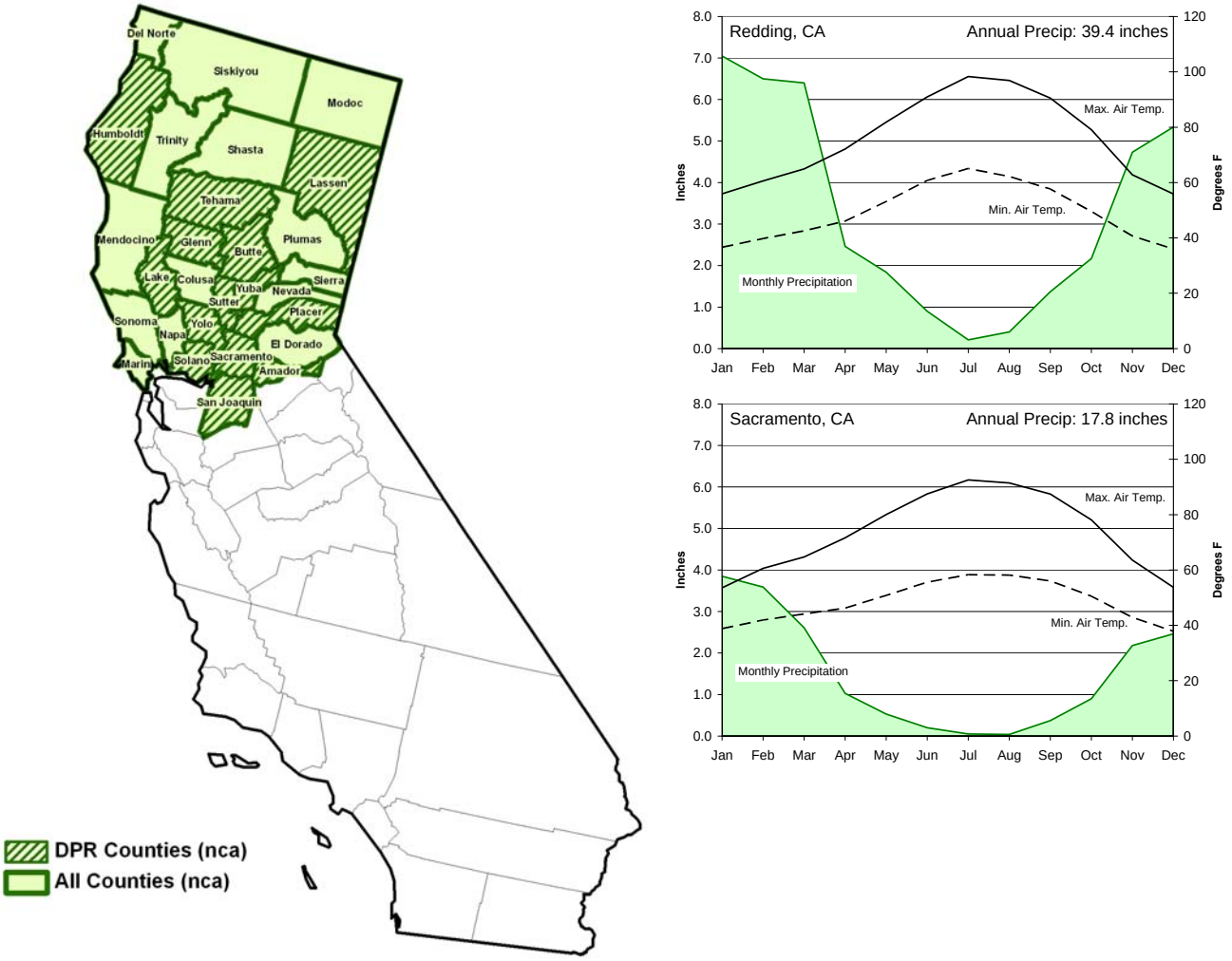



Table 5 describes the farm/land resources, capital and market values, livestock numbers, and field crop production. The values are imputed by USDA, although the land rent is from survey data. The last few rows describe the distribution of crops in the region by crop category: grains, vegetables, fruits/nuts, and nursery crops. Fruits, tree nuts, and berries, account for over half the crop production (55 percent).

**Table 5: NCA summary production statistics from 2007 USDA, Census of Agriculture**

| Northern California (NCA) | | | Acres |
|---|---|---|---|
| Farms | | | 30,601 |
| Land in farms (acres) | | | 9,322,223 |
| Average size of farm (acres) | | | 305 |
| Total cropland (farms) | | | 22,016 |
| Total cropland (acres) | | | 3,189,951 |
| Irrigated land (farms) | | | 19,645 |
| Irrigated land (acres) | | | 2,732,992 |
| Irrigated land (acres)/Total cropland (acres) | | | 85.7% |
| Value of Capital and Production | | | |
| Land Rent (USDA, NASS, 2008), Irrigated cropland ($/acre) | | | $264 |
| Market value of all mach and equip ($) | | | $2,814,866,126 |
| Market value of land and bldgs ($) | | | $55,701,335,427 |
| Market value of land and bldgs, Ave.($)/acre | | | $5,975 |
| Market value of ag products sold ($1,000) | | | $6,102,803 |
| Market value of all crops ($1,000) | | | $4,522,114 |
| Market value of crops/all ag products (%) | | | 74.1% |
| Livestock | | Sales | Inventory |
| Cattle and calves inventory | | | 1,030,948 |
| Cattle and calves inventory \ Beef cows | | | 253,065 |
| Cattle and calves inventory \ Milk cows | | | 223,139 |
| Cattle and calves sold (number) | | 521,794 | |
| Hogs and pigs (number) | | 25,678 | 9,739 |
| Sheep and lambs inventory (number) | | | 172,747 |
| Layers inventory (see text) (number) | | | 3,501,263 |
| Broilers and other meat-type chickens sold | | 6,336,283 | |
| Crop Production (Units) | Yield (unit/ac) | Unit harv. | Acres |
| Corn for grain (bushels) | 183.7 | 23,288,827 | 126,753 |
| Corn for silage or greenchop (tons) | 27.0 | 1,582,566 | 58,531 |
| Wheat for grain, all (bushels) | 81.4 | 11,620,816 | 142,820 |
| Oats for grain (bushels) | 85.5 | 522,053 | 6,109 |
| Barley for grain (bushels) | 78.3 | 1,067,524 | 13,632 |
| Sorghum for grain (bushels) | 78.5 | 373,354 | 4,754 |
| Sorghum for silage or greenchop (tons) | 11.0 | 10,283 | 931 |
| Dry edible beans, excluding limas (cwt) | 19.8 | 393,486 | 19,903 |
| Cotton, all (bales) | 3.1 | 14,282 | 4,579 |
| Forage - hay, silage, and greenchop (tons) | 4.7 | 2,853,744 | 606,086 |
| Rice (cwt) | 81.3 | 42,402,855 | 521,502 |
| Sunflower seed, all (pounds) | 1,090.5 | 27,536,620 | 25,251 |
| Sugarbeets for sugar (tons) | 31.0 | 19,375 | 625 |
| Value of Sales and Crop Value Distribution | | | |
| Crops, including nursery and greenhouse ($1,000) | | | $4,522,114 |
| Grains, oilseeds, dry beans, and hay | | 21.2% | $958,184 |
| Vegetables, melons, potatoes, and sweet potatoes | | 13.4% | $607,046 |
| Fruits, tree nuts, and berries | | 54.6% | $2,469,842 |
| Nursery, greenhouse, floriculture, and sod | | 8.6% | $390,718 |

### 1.3.2 Central California (CEN)

Figure 13 presents the counties included in the CEN region. It also includes the precipitation and weather data for Fresno, CA. Fresno has an average annual precipitation of 11.2 inches. Rainfall in this CEN region is insufficient for rainfed crops and requires access to reliable quantities of irrigated water to produce the valuable food crops.

**Figure 13: Counties and rainfall for the Central California region**

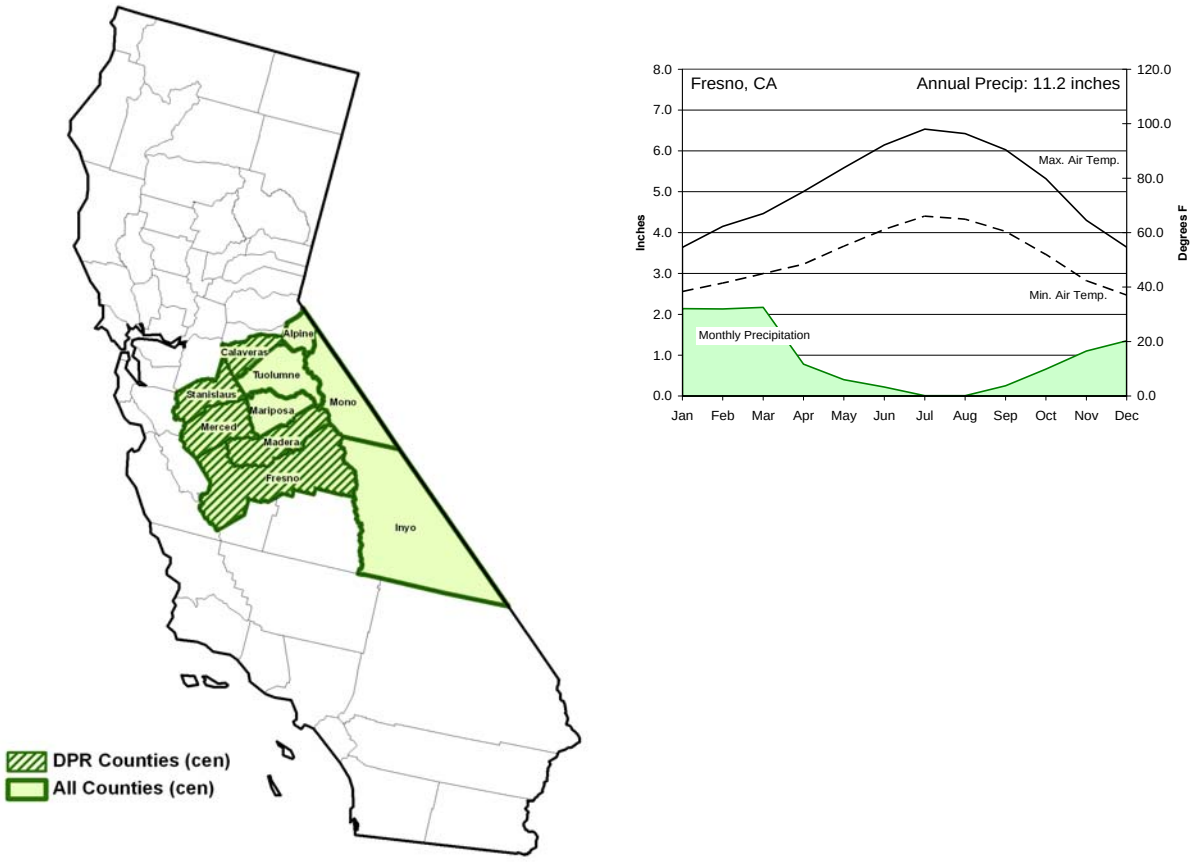



Table 6 describes the farm/land resources, capital and market values, livestock numbers, and field crop production. The values are imputed by USDA, although the land rent is from survey data. The last few rows describe the distribution of crops in the region by crop category: grains, vegetables, fruits/nuts, and nursery crops. Fruits, tree nuts, and berries, account for over half the crop production (61 percent).

**Table 6: CEN summary production statistics from 2007 USDA Census of Agriculture**

| Central California (CEN) | | | Acres |
|---|---|---|---|
| Farms | | | 15,994 |
| Land in farms (acres) | | | 5,015,629 |
| Average size of farm (acres) | | | 314 |
| Total cropland (farms) | | | 12,451 |
| Total cropland (acres) | | | 2,323,083 |
| Irrigated land (farms) | | | 11,855 |
| Irrigated land (acres) | | | 2,217,042 |
| Irrigated land (acres)/Total cropland (acres) | | | 95.4% |
| Value of Capital and Production | | | |
| Land Rent (USDA, NASS, 2008), Irrigated cropland ($/acre) | | | $250 |
| Market value of all mach and equip ($) | | | $2,223,755,004 |
| Market value of land and bldgs ($) | | | $34,477,243,464 |
| Market value of land and bldgs, Ave.($)/acre | | | $6,874 |
| Market value of ag products sold ($1,000) | | | $8,942,476 |
| Market value of all crops ($1,000) | | | $4,756,520 |
| Market value of crops/all ag products (%) | | | 53.2% |
| Livestock | | Sales | Inventory |
| Cattle and calves inventory | | | 1,667,664 |
| Cattle and calves inventory \ Beef cows | | | 127,250 |
| Cattle and calves inventory \ Milk cows | | | 656,599 |
| Cattle and calves sold (number) | | 1,095,101 | |
| Hogs and pigs (number) | | 75,515 | 37,430 |
| Sheep and lambs inventory (number) | | | 85,831 |
| Layers inventory (see text) (number) | | | 5,890,360 |
| Broilers and other meat-type chickens sold | | 92,852,417 | |
| Crop Production (Units) | Yield (unit/ac) | Unit harv. | Acres |
| Corn for grain (bushels) | 175.1 | 5,691,658 | 32,507 |
| Corn for silage or greenchop (tons) | 26.0 | 4,885,748 | 188,204 |
| Wheat for grain, all (bushels) | 90.2 | 4,182,063 | 46,360 |
| Oats for grain (bushels) | 105.3 | 1,506,725 | 14,304 |
| Barley for grain (bushels) | 47.7 | 391,141 | 8,204 |
| Sorghum for grain (bushels) | 79.0 | 88,899 | 1,126 |
| Sorghum for silage or greenchop (tons) | 13.3 | 97,693 | 7,341 |
| Dry edible beans, excluding limas (cwt) | 20.0 | 73,302 | 3,656 |
| Cotton, all (bales) | 3.0 | 616,010 | 203,729 |
| Cotton, all \ Upland cotton (bales) | 3.2 | 312,388 | 99,018 |
| Cotton, all \ Pima cotton (bales) | 2.9 | 282,864 | 98,062 |
| Forage - hay, silage, and greenchop (tons) | 6.8 | 2,500,010 | 368,818 |
| Rice (cwt) | 62.8 | 525,406 | 8,366 |
| Sunflower seed, all (pounds) | | 93,300 | |
| Sugarbeets for sugar (tons) | 33.3 | 432,306 | 12,987 |
| Value of Sales and Crop Value Distribution | | | |
| Crops, including nursery and greenhouse ($1,000) | | | $4,756,520 |
| Grains, oilseeds, dry beans, and hay | | 11.4% | $540,583 |
| Vegetables, melons, potatoes, and sweet potatoes | | 21.8% | $1,037,263 |
| Fruits, tree nuts, and berries | | 61.3% | $2,917,278 |
| Nursery, greenhouse, floriculture, and sod | | 4.3% | $205,204 |

### 1.3.3 Southern San Joaquin (SSJ)

Figure 14 presents the counties included in the SSJ region. It also includes the precipitation and weather data for Bakersfield, CA. Bakersfield has an average annual precipitation of 6.5 inches. Rainfall in this SSJ region is insufficient for rainfed crops and requires access to reliable quantities of irrigated water to produce the valuable food crops.

**Figure 14: Counties and rainfall for the South San Joaquin Valley region**

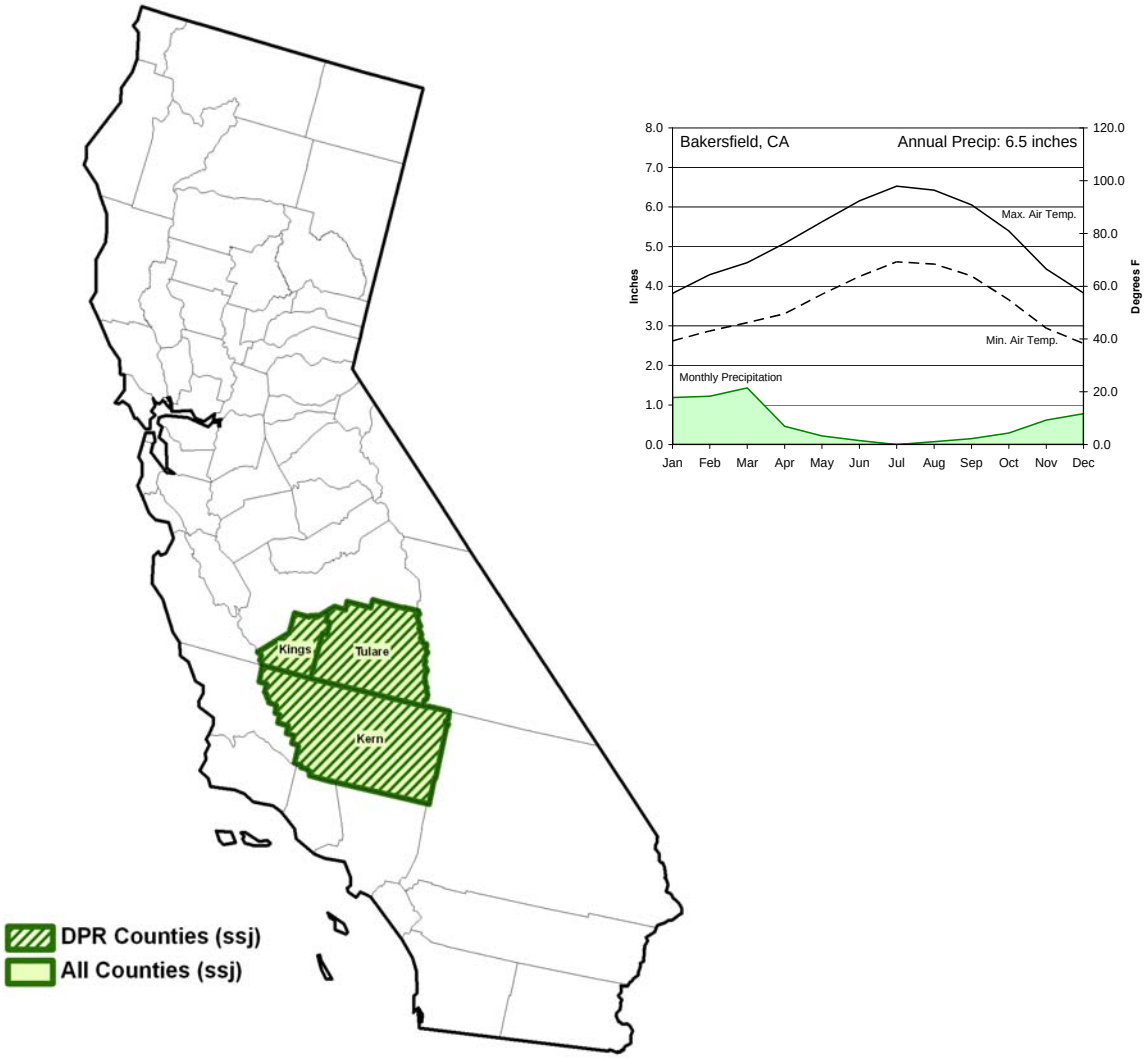



Table 7 describes the farm/land resources, capital and market values, livestock numbers, and field crop production. The values are imputed by USDA, although the land rent is from survey data. The last few rows describe the distribution of crops in the region by crop category: grains,

vegetables, fruits/nuts, and nursery crops. Fruits, tree nuts, and berries, account for over half the crop production (67 percent).

**Table 7: SSJ summary production statistics from 2007 USDA Census of Agriculture**

| South San Joaquin (SSJ) | | | Acres |
|---|---|---|---|
| Farms | | | 8,486 |
| Land in farms (acres) | | | 4,211,111 |
| Average size of farm (acres) | | | 496 |
| Total cropland (farms) | | | 6,846 |
| Total cropland (acres) | | | 2,094,486 |
| Irrigated land (farms) | | | 6,117 |
| Irrigated land (acres) | | | 1,758,168 |
| Irrigated land (acres)/Total cropland (acres) | | | 83.9% |
| Value of Capital and Production | | | |
| Land Rent (USDA, NASS, 2008), Irrigated cropland ($/acre) | | | $222 |
| Market value of all mach and equip ($) | | | $1,468,606,685 |
| Market value of land and bldgs ($) | | | $24,305,454,077 |
| Market value of land and bldgs, Ave.($)/acre | | | $5,772 |
| Market value of ag products sold ($1,000) | | | $7,897,571 |
| Market value of all crops ($1,000) | | | $4,410,224 |
| Market value of crops/all ag products (%) | | | 55.8% |
| Livestock | | Sales | Inventory |
| Cattle and calves inventory | | | 1,774,662 |
| Cattle and calves inventory \ Beef cows | | | 67,386 |
| Cattle and calves inventory \ Milk cows | | | 762,853 |
| Cattle and calves sold (number) | | 1,126,294 | |
| Hogs and pigs (number) | | 3,610 | 1,614 |
| Sheep and lambs inventory (number) | | | 175,720 |
| Layers inventory (see text) (number) | | | 18,347 |
| Broilers and other meat-type chickens sold | | 14,309,043 | |
| Crop Production (Units) | Yield (unit/ac) | Unit harv. | Acres |
| Corn for grain (bushels) | 187.9 | 5,160,032 | 27,459 |
| Corn for silage or greenchop (tons) | 25.9 | 5,329,385 | 205,417 |
| Wheat for grain, all (bushels) | 83.1 | 9,036,553 | 108,723 |
| Oats for grain (bushels) | 114.7 | 214,172 | 1,868 |
| Barley for grain (bushels) | 96.5 | 411,228 | 4,263 |
| Sorghum for grain (bushels) | 20.3 | 378,045 | 18,592 |
| Dry edible beans, excluding limas (cwt) | 24.5 | 182,861 | 7,466 |
| Cotton, all (bales) | 2.9 | 717,655 | 243,511 |
| Forage - hay, silage, and greenchop (tons) | 7.6 | 2,869,204 | 375,950 |
| Sugarbeets for sugar (tons) | 30.3 | 107,185 | 3,538 |
| Value of Sales and Crop Value Distribution | | | |
| Crops, including nursery and greenhouse ($1,000) | | | $4,410,224 |
| Grains, oilseeds, dry beans, and hay | | 16.3% | $717,532 |
| Vegetables, melons, potatoes, and sweet potatoes | | 11.9% | $524,160 |
| Fruits, tree nuts, and berries | | 66.9% | $2,948,301 |
| Nursery, greenhouse, floriculture, and sod | | 4.9% | $215,946 |

### 1.3.4 Southern-most California (SCA)

Figure 15 presents the counties included in the SCA region. It also includes the precipitation and weather data for El Centro, CA. El Centro has an average annual precipitation of 2.9 inches. Rainfall in this SCA region is insufficient for rainfed crops and requires access to reliable quantities of irrigated water to produce the valuable food crops. High temperatures and an annual average rainfall of 3 inches require irrigation for the production of the $3.1 billion value of annual crop production this SCA region produces each year.

**Figure 15: Counties and rainfall for the Southern-most California region**

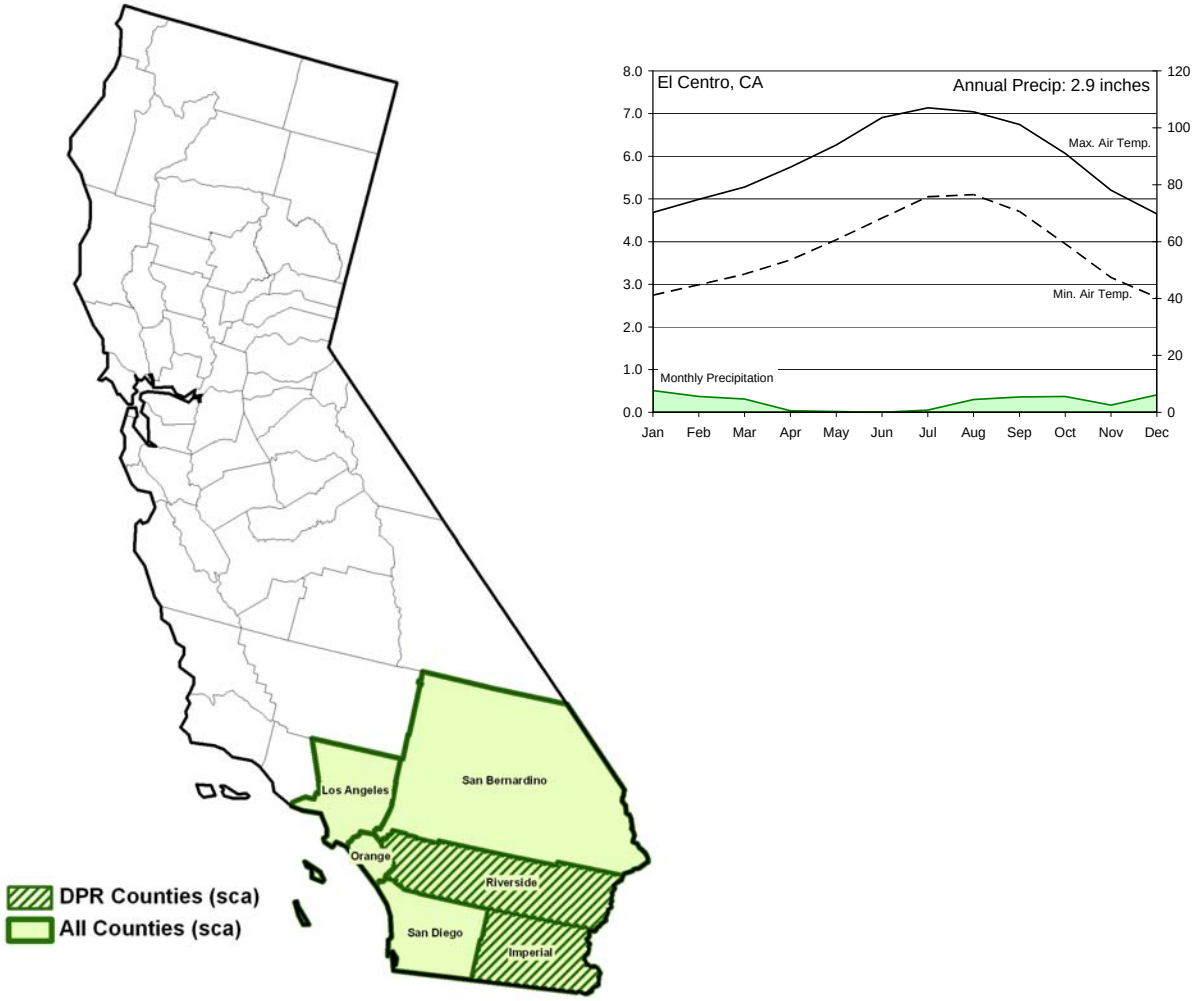



Table 8 describes the farm/land resources, capital and market values, livestock numbers, and field crop production. The values are imputed by USDA, although the land rent is from survey data. The last few rows describe the distribution of crops in the region by crop category: grains,

vegetables, fruits/nuts, and nursery crops. Nursery, greenhouse, floriculture, and sod, predominate this region's crop production (45 percent).

**Table 8: SCA summary production statistics from 2007 USDA Census of Agriculture**

| Southern-most California (SCA) | | | Acres |
|---|---|---|---|
| Farms | | | 14,066.0 |
| Land in farms (acres) | | | 1,796,123.0 |
| Average size of farm (acres) | | | 128 |
| Total cropland (farms) | | | 10,846 |
| Total cropland (acres) | | | 818,787 |
| Irrigated land (farms) | | | 8,997 |
| Irrigated land (acres) | | | 674,441 |
| Irrigated land (acres)/Total cropland (acres) | | | 82.4% |
| Value of Capital and Production | | | |
| Land Rent (USDA, NASS, 2008), Irrigated cropland ($/acre) | | | $492 |
| Market value of all mach and equip ($) | | | $976,071,034 |
| Market value of land and bldgs ($) | | | $17,909,460,048 |
| Market value of land and bldgs, Ave.($)/acre | | | $4,758 |
| Market value of ag products sold ($1,000) | | | $4,762,407 |
| Market value of all crops ($1,000) | | | $3,170,154 |
| Market value of crops/all ag products (%) | | | 66.6% |
| Livestock | | Sales | Inventory |
| Cattle and calves inventory | | | 775,964 |
| Cattle and calves inventory \ Beef cows | | | 18,476 |
| Cattle and calves inventory \ Milk cows | | | 180,685 |
| Cattle and calves sold (number) | | 633,537 | |
| Hogs and pigs (number) | | 7,990 | 4,182 |
| Sheep and lambs inventory (number) | | | 119,035 |
| Layers inventory (see text) (number) | | | 8,974,905 |
| Broilers and other meat-type chickens sold | | 332 | |
| Crop Production (Units) | Yield (unit/ac) | Unit harv. | Acres |
| Corn for silage or greenchop (tons) | 25.6 | 154,757 | 6,057 |
| Wheat for grain, all (bushels) | 98.3 | 4,704,429 | 47,844 |
| Oats for grain (bushels) | 109.8 | 143,152 | 1,304 |
| Barley for grain (bushels) | 59.3 | 7,584 | 128 |
| Sorghum for silage or greenchop (tons) | 15.5 | 37,345 | 2,406 |
| Forage - hay, silage, and greenchop (tons) | 7.1 | 2,242,491 | 313,692 |
| Sugarbeets for sugar (tons) | 38.0 | 970,282 | 25,532 |
| Value of Sales and Crop Value Distribution | | | |
| Crops, including nursery and greenhouse ($1,000) | | | $3,170,154 |
| Grains, oilseeds, dry beans, and hay | | 12.4% | $391,628 |
| Vegetables, melons, potatoes, and sweet potatoes | | 22.7% | $720,670 |
| Fruits, tree nuts, and berries | | 18.9% | $599,705 |
| Nursery, greenhouse, floriculture, and sod | | 45.4% | $1,439,790 |

### 1.3.5 Central Coast (COA)

Figure 16 presents the counties included in the COA region. It also includes the precipitation and weather data for Monterey, CA. Monterey has an average annual precipitation of 20.3 inches. The coastal regions receive higher rainfall than most of the growing areas and the temperatures are more moderate year-round than the other areas. Crop production in this area competes with urban needs. The areas land rent of more than $1,000 limits crop production here to those food crops of highest value.

**Figure 16. Counties and rainfall for the Central Coastal region**

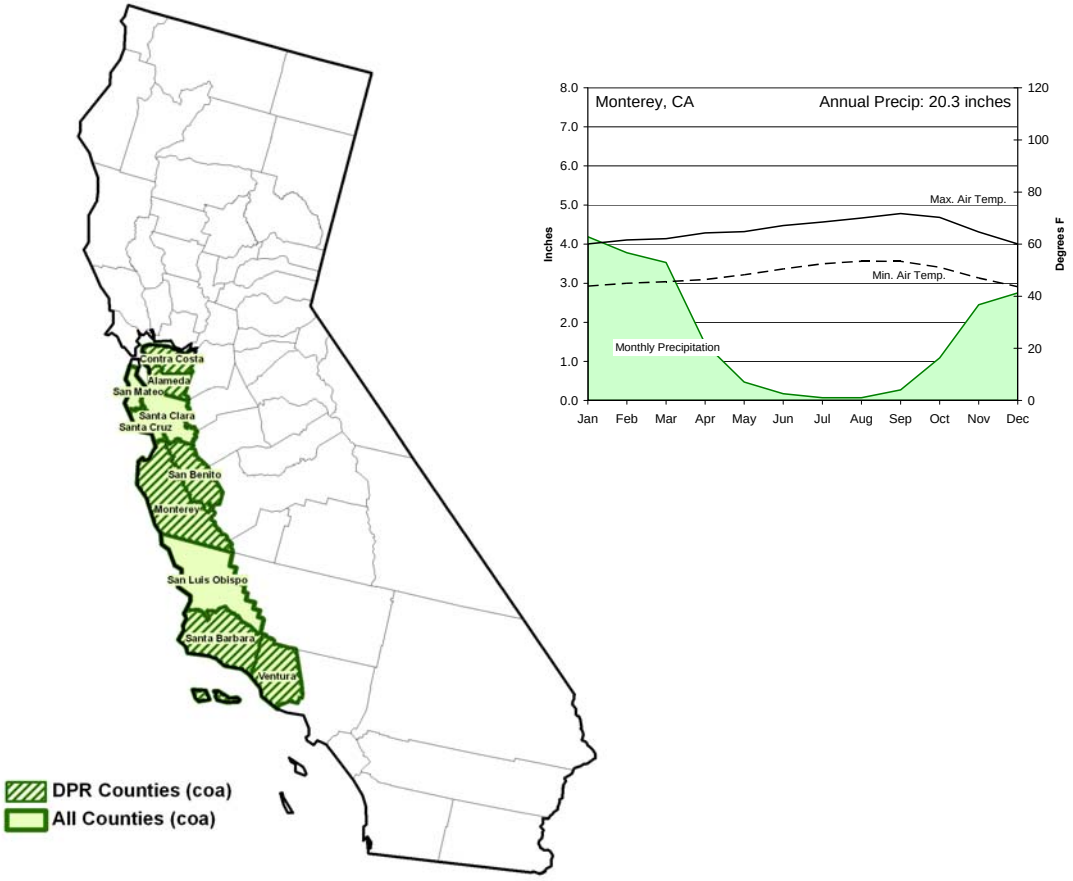



Table 9 describes the farm/land resources, capital and market values, livestock numbers, and field crop production. The values are imputed by USDA, although the land rent is from survey data. The last few rows describe the distribution of crops in the region by crop category: grains,

vegetables, fruits/nuts, and nursery crops. High-valued vegetable crops predominate with very little grain, oilseeds, or hay in production.

**Table 9: COA summary production statistics from 2007 USDA Census of Agriculture**

| Central Coast (COA) | | | Acres |
|---|---|---|---|
| Farms | | | 11,886 |
| Land in farms (acres) | | | 5,019,609 |
| Average size of farm (acres) | | | 422 |
| Total cropland (farms) | | | 9,056 |
| Total cropland (acres) | | | 1,038,340 |
| Irrigated land (farms) | | | 6,786 |
| Irrigated land (acres) | | | 631,162 |
| Irrigated land (acres)/Total cropland (acres) | | | 60.8% |
| Value of Capital and Production | | | |
| Land Rent (USDA, NASS, 2008), Irrigated cropland ($/acre) | | | $1,041 |
| Market value of all mach and equip ($) | | | $1,280,000,960 |
| Market value of land and bldgs ($) | | | $30,139,900,305 |
| Market value of land and bldgs, Ave.($)/acre | | | $8,024 |
| Market value of ag products sold ($1,000) | | | $6,170,285 |
| Market value of all crops ($1,000) | | | $5,947,494 |
| Market value of crops/all ag products (%) | | | 96.4% |
| Livestock | | Sales | Inventory |
| Cattle and calves inventory | | | 248,787 |
| Cattle and calves inventory \ Beef cows | | | 78,720 |
| Cattle and calves inventory \ Milk cows | | | 7,469 |
| Cattle and calves sold (number) | | 176,804 | |
| Hogs and pigs (number) | | 3,607 | 1,198 |
| Sheep and lambs inventory (number) | | | 15,957 |
| Layers inventory (see text) (number) | | | 18,404 |
| Broilers and other meat-type chickens sold | | 271,396 | |
| Crop Production (Units) | Yield (unit/ac) | Unit harv. | Acres |
| Corn for grain (bushels) | 112.7 | 201,935 | 1,792 |
| Wheat for grain, all (bushels) | 87.5 | 453,897 | 5,190 |
| Oats for grain (bushels) | 59.3 | 89,821 | 1,515 |
| Barley for grain (bushels) | 38.7 | 514,641 | 13,296 |
| Dry edible beans, excluding limas (cwt) | 18.9 | 33,800 | 1,790 |
| Forage - hay, silage, and greenchop (tons) | 3.0 | 174,576 | 58,418 |
| Value of Sales and Crop Value Distribution | | | |
| Crops, including nursery and greenhouse ($1,000) | | | $5,947,494 |
| Grains, oilseeds, dry beans, and hay | | 0.21% | $12,315 |
| Vegetables, melons, potatoes, and sweet potatoes | | 42.6% | $2,533,125 |
| Fruits, tree nuts, and berries | | 35.6% | $2,119,265 |
| Nursery, greenhouse, floriculture, and sod | | 21.1% | $1,252,446 |

# CHAPTER 2: Methodology

To model the crop cover shifts from economically-driven cropping pattern decisions, three datasets have been developed. The universe of crop choices is based on the 24 crops utilized in the multidimensional scaling of the California pesticide use analysis described above. The first dataset is based on this historical representation of cropping pattern choice on 640 acre sections. The second dataset is the historical crop acreage data developed by the California Agricultural Commissioners. The third dataset is based on the economic crop enterprise budgets developed from the University of California-Davis, Cost and Return Studies, on-farm interviews, and best professional judgment.

## 2.1 Establishing Cropping Systems/Patterns

Alonso and Kaffka (2009) partitioned data from the California Department of Pesticide Regulation (DPR) into 5 principal cropping regions. As an example, the 10-year crop frequency scores for the 9-cluster result of the northern California region is presented for each of the 24 crops in Table 10. These scores served as a weighting factor to establish the predominant cropping patterns within each cluster.

**Table 10: 10-year crop frequency scores for Northern California**

| | Cluster 1 | Cluster 2 | Cluster 3 | Cluster 4 | Cluster 5 | Cluster 6 | Cluster 7 | Cluster 8 | Cluster 9 |
|---|---|---|---|---|---|---|---|---|---|
| Alfalfa | 0.37 | 4.67 | 0.09 | 6.65 | 0.16 | 5.80 | 0.54 | 0.22 | 8.70 |
| Barley | 0.09 | 0.12 | 0.02 | 0.11 | 0.22 | 0.16 | 0.03 | 0.30 | 0.09 |
| Beans | 0.21 | 1.25 | 0.11 | 0.39 | 2.77 | 0.38 | 2.49 | 0.90 | 1.48 |
| Bermudagrass | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Broccoli | 0.00 | 0.04 | 0.00 | 0.03 | 0.21 | 0.00 | 0.01 | 0.03 | 0.07 |
| Carrots | 0.01 | 0.14 | 0.01 | 0.04 | 0.19 | 0.12 | 0.24 | 0.07 | 0.18 |
| Corn | 0.92 | 2.71 | 0.26 | 2.27 | 2.94 | 1.27 | 1.27 | 2.57 | 2.70 |
| Cotton | 0.02 | 0.12 | 0.08 | 0.05 | 0.09 | 0.21 | 0.27 | 0.13 | 0.19 |
| Forage Grasses | 0.05 | 0.06 | 0.00 | 0.13 | 0.06 | 0.09 | 0.00 | 0.04 | 0.11 |
| Garlic | 0.02 | 0.02 | 0.00 | 0.03 | 0.06 | 0.00 | 0.00 | 0.00 | 0.02 |
| Lettuce | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 |
| Melons | 0.11 | 0.60 | 0.11 | 0.17 | 1.30 | 0.32 | 2.28 | 0.53 | 0.55 |
| Oats | 0.62 | 0.56 | 0.12 | 1.16 | 0.44 | 1.09 | 0.13 | 0.32 | 0.90 |
| Onion | 0.05 | 0.50 | 0.03 | 0.09 | 0.78 | 0.17 | 0.42 | 0.28 | 0.49 |
| Potato | 0.05 | 0.04 | 0.00 | 0.03 | 0.02 | 0.00 | 0.00 | 0.20 | 0.01 |
| Rape | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rice | 0.16 | 0.08 | 8.73 | 0.06 | 0.26 | 8.27 | 7.22 | 0.19 | 0.13 |
| Ryegrass | 0.04 | 0.09 | 0.00 | 0.20 | 0.03 | 0.12 | 0.02 | 0.04 | 0.16 |
| Safflower | 0.08 | 0.92 | 0.14 | 0.25 | 1.19 | 0.35 | 2.29 | 0.48 | 1.19 |
| Sorghum | 0.05 | 0.15 | 0.03 | 0.26 | 0.09 | 0.12 | 0.13 | 0.17 | 0.21 |
| Sudangrass | 0.12 | 0.06 | 0.03 | 0.14 | 0.01 | 0.12 | 0.01 | 0.05 | 0.15 |
| Sugarbeet | 0.04 | 0.37 | 0.03 | 0.30 | 0.27 | 0.16 | 0.06 | 0.18 | 0.53 |
| Tomato | 0.12 | 5.11 | 0.15 | 0.69 | 6.88 | 0.54 | 3.94 | 1.83 | 5.74 |
| Wheat | 0.59 | 4.18 | 0.25 | 1.47 | 5.79 | 1.65 | 3.28 | 2.98 | 4.53 |

The frequency score for each crop within a cluster was summed to determine crop distribution. This weighted crop distribution is the foundation of the cropping pattern assignment. Since each record within the DPR represents a 640-acre section, each crop distribution can be multiplied by 640 acres to illustrate prominent crop choices.

The individual crop scores, and weighted distribution, are presented in Table 11. Some crops occur more frequently than others. The most frequent crops within clusters were identified to narrow the inputs into the economic optimization. The fewest number of crops that account for 90 percent of distribution within the cluster serves as the cropping pattern selection metric. The last crop included in the cropping rotation is the next smallest distribution that accounted for 90 percent of the frequency score. In Table 11, Cluster 1 has a cropping pattern of the 13 most frequent crops in the cluster. Once the number of crops has been determined the distributions were rescaled by 90 percent across cropping pattern crops so that the cropping pattern crops summed to 100 percent.

**Table 11: Crop distribution of Cluster #1 in the northern region of California**

| Crop | Score | Distribution % | Adjusted | Acres |
|---|---|---|---|---|
| **Corn** | **0.924** | **24.8%** | **27.5%** | **176.0** |
| **Oats** | **0.623** | **16.7%** | **18.5%** | **118.7** |
| **Wheat** | **0.592** | **12.2%** | **13.5%** | **86.6** |
| **Alfalfa** | **0.373** | **10.0%** | **11.1%** | **71.1** |
| **Beans** | **0.211** | **5.6%** | **6.3%** | **40.1** |
| **Rice** | **0.155** | **4.2%** | **4.6%** | **29.6** |
| **Sudangras** | **0.119** | **3.2%** | **3.6%** | **22.7** |
| **Tomato** | **0.118** | **3.2%** | **3.5%** | **22.4** |
| **Melons** | **0.106** | **2.8%** | **3.2%** | **20.2** |
| **Barley** | **0.094** | **2.5%** | **2.8%** | **17.8** |
| **Safflower** | **0.076** | **2.0%** | **2.3%** | **14.4** |
| **Potato** | **0.054** | **1.4%** | **1.6%** | **10.2** |
| **Onion** | **0.052** | **1.4%** | **1.6%** | **10.0** |
| Sorghum | 0.052 | 1.4% | | |
| Forage Gra | 0.049 | 1.3% | | |
| Sugarbeet | 0.042 | 1.1% | | |
| Ryegrass | 0.035 | 0.9% | | |
| Cotton | 0.018 | 0.5% | | |
| Garlic | 0.018 | 0.5% | | |
| Carrots | 0.015 | 0.4% | | |
| Broccoli | 0.004 | 0.1% | | |
| Lettuce | 0.004 | 0.1% | | |
| Bermudagra | 0.000 | 0.0% | | |
| Rape | 0.000 | 0.0% | | |
| **Totals** | **3.733** | **90.0%** | **100.0%** | **640.0** |

The DPR data covers 10 years of cropping activities. Currently there is no processing capacity for sugarbeets in this northern region and no sugarbeets are grown now. Sugarbeets have been retained because production would resume if an energy-based sugarbeet processing plant opened.

Wheat is frequently double-cropped. If the basic relationship is one crop per acre, then multiple crops per acre distort that relationship. Crops that are frequently double cropped with wheat are dry edible beans, melons and sudangrass. The sum of these crop acres were used to reduce wheat double-crop acreage to avoid counting the acreage twice. The total wheat acreage was reduced to 76.8 percent of the original wheat acreage amount. This adjusted wheat acreage is included in the economic optimization model.

To further illustrate the diversity of the cropping patterns within each cluster, Cluster #3 and # 7 are presented in Tables 12 and 13, respectively. The original crop distribution scores are

provided in the table, while the crops selected for the Cluster cropping rotation are outlined in a dark border and with bolded text. The corrected distributions for wheat are highlighted.

**Table 12: Crop distribution of Cluster #3 in the northern region of California**

| Crop | Score | Distribution % | Adjusted | Acres |
|---|---|---|---|---|
| **Rice** | **8.732** | **85.6%** | **95.0%** | **608.2** |
| **Corn** | **0.265** | **2.6%** | **2.9%** | **18.4** |
| **Wheat** | **0.249** | **1.9%** | **2.1%** | **13.3** |
| Tomato | 0.152 | 1.5% | | |
| Safflower | 0.142 | 1.4% | | |
| Oats | 0.119 | 1.2% | | |
| Beans | 0.110 | 1.1% | | |
| Melons | 0.110 | 1.1% | | |
| Alfalfa | 0.089 | 0.9% | | |
| Cotton | 0.079 | 0.8% | | |
| Sudangrass | 0.034 | 0.3% | | |
| Onion | 0.028 | 0.3% | | |
| Sorghum | 0.028 | 0.3% | | |
| Sugarbeet | 0.028 | 0.3% | | |
| Barley | 0.019 | 0.2% | | |
| Carrots | 0.008 | 0.1% | | |
| Forage Grasses | 0.003 | 0.0% | | |
| Ryegrass | 0.003 | 0.0% | | |
| Broccoli | 0.001 | 0.0% | | |
| Potato | 0.001 | 0.0% | | |
| Bermudagrass | 0.000 | 0.0% | | |
| Garlic | 0.000 | 0.0% | | |
| Lettuce | 0.000 | 0.0% | | |
| Rape | 0.000 | 0.0% | | |
| **Totals** | **10.199** | **90.1%** | **100.0%** | **640.0** |

**Table 13: Crop distribution of Cluster #7 in the northern region of California**

| Crop | Score | Distribution % | Adjusted | Acres |
|---|---|---|---|---|
| **Rice** | **7.215** | **29.3%** | **32.0%** | **204.7** |
| **Tomato** | **3.944** | **16.0%** | **17.5%** | **111.9** |
| **Wheat** | **3.285** | **10.2%** | **11.2%** | **71.6** |
| **Beans** | **2.486** | **10.1%** | **11.0%** | **70.5** |
| **Safflower** | **2.292** | **9.3%** | **10.2%** | **65.0** |
| **Melons** | **2.285** | **9.3%** | **10.1%** | **64.8** |
| **Corn** | **1.271** | **5.2%** | **5.6%** | **36.1** |
| **Alfalfa** | **0.542** | **2.2%** | **2.4%** | **15.4** |
| Onion | 0.424 | 1.7% | | |
| Cotton | 0.271 | 1.1% | | |
| Carrots | 0.236 | 1.0% | | |
| Oats | 0.132 | 0.5% | | |
| Sorghum | 0.125 | 0.5% | | |
| Sugarbeet | 0.063 | 0.3% | | |
| Barley | 0.028 | 0.1% | | |
| Ryegrass | 0.021 | 0.1% | | |
| Broccoli | 0.014 | 0.1% | | |
| Sudangrass | 0.014 | 0.1% | | |
| Bermudagrass | 0.000 | 0.0% | | |
| Forage Grasses | 0.000 | 0.0% | | |
| Garlic | 0.000 | 0.0% | | |
| Lettuce | 0.000 | 0.0% | | |
| Potato | 0.000 | 0.0% | | |
| Rape | 0.000 | 0.0% | | |
| **Totals** | **24.646** | **91.5%** | **100%** | **640.0** |

The current cropping patterns for each cluster in the northern region of California are presented in Table 14. Each cluster indicates the predominant cropping patterns for each hypothetical, representative farm (1 cluster = 1 representative farm). Fifteen of the initial twenty-four crops are grown in the northern region. In Table 14 the percentages sum to 100 by column. Table 14 is derived from Table 10. Each column in Table 14 represents about 90 percent of the frequency distribution of the corresponding column in Table 10.

**Table 14: Nine predominant cropping patterns for each cluster/hypothetical farm (CL = Cluster), NCA Region**

| | CL1 | CL2 | CL3 | CL4 | CL5 | CL6 | CL7 | CL8 | CL9 |
|---|---|---|---|---|---|---|---|---|---|
| **Alfalfa** | 11.1% | 23.5% | | 50.8% | | 30.6% | 2.4% | 2.1% | 33.8% |
| **Barley** | 2.8% | | | | 1.0% | | | 2.9% | |
| **Beans** | 6.3% | 6.3% | | 3.0% | 12.9% | 2.0% | 11.0% | 8.6% | 5.8% |
| **Corn** | 27.5% | 13.6% | 2.9% | 17.4% | 13.7% | 6.7% | 5.6% | 24.6% | 10.5% |
| **Melons** | 3.2% | 3.0% | | | 6.1% | | 10.1% | 5.1% | 2.2% |
| **Oats** | 18.5% | 2.8% | | 8.8% | 2.1% | 5.8% | | 3.0% | 3.5% |
| **Onion** | 1.6% | 2.5% | | | 3.6% | | | 2.7% | 1.9% |
| **Potato** | 1.6% | | | | | | | 1.9% | |
| **Rice** | 4.6% | | 95.0% | | 1.2% | 43.6% | 32.0% | 1.8% | |
| **Safflower** | 2.3% | 4.6% | | 1.9% | 5.5% | 1.8% | 10.2% | 4.6% | 4.6% |
| **Sorghum** | | | | 2.0% | | | | 1.6% | |
| **Sudangrass** | 3.6% | | | | | | | | |
| **Sugarbeet** | | 1.9% | | 2.3% | 1.2% | | | 1.7% | 2.1% |
| **Tomato** | 3.5% | 25.7% | | 5.3% | 32.0% | 2.9% | 11.2% | 17.5% | 22.3% |
| **Wheat** | 13.5% | 16.2% | 2.1% | 8.7% | 20.7% | 6.7% | 17.5% | 21.9% | 13.5% |
| | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

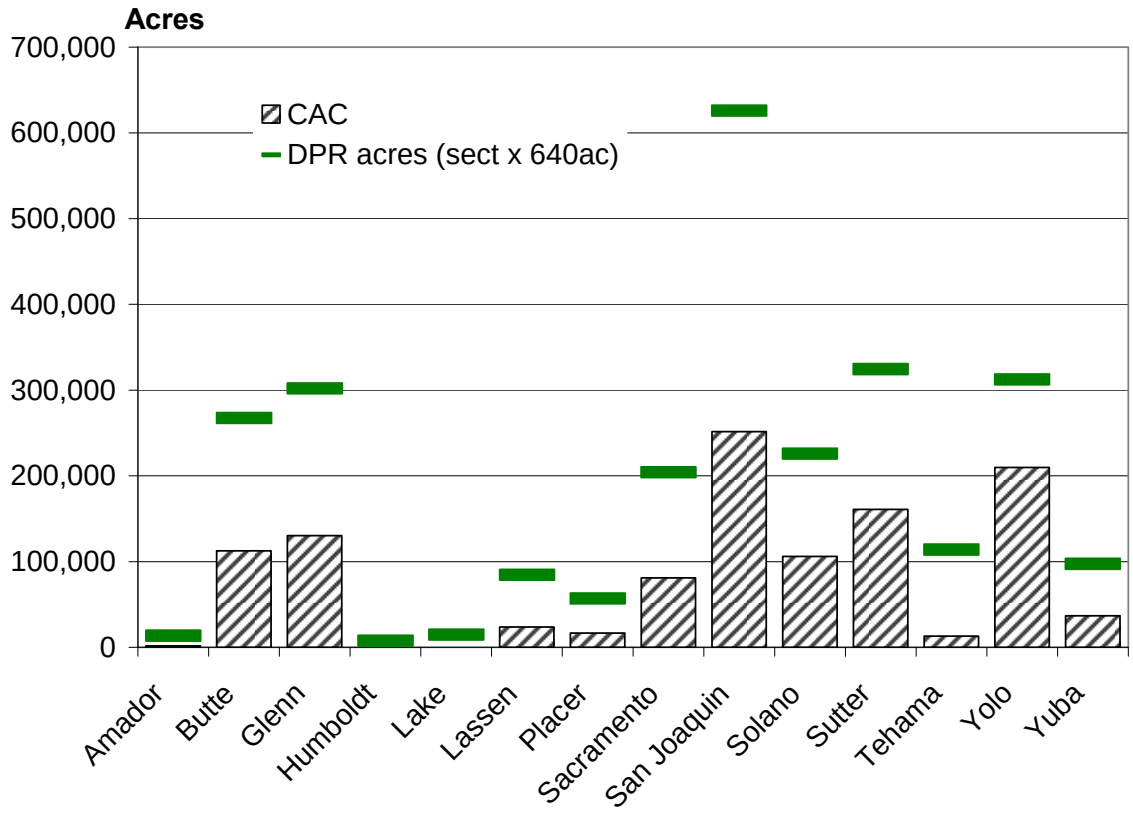
## 2.2 Establishing Historical Acreage by County and Crop

The Department of Pesticide Regulation (DPR) dataset contains the acreage data for each crop within a designated 640-acre section. Complications with consistent applicability of the DPR acreage data created challenges in this analysis. To help address this limitation, the historical crop data in the California, County Agricultural Commission dataset (CAC) was developed as an alternative benchmark for comparison with the DPR acreage. CAC historical acreage data for all the available crops was collected and sorted. Current county-level acreage data represents the average of five years (2004-2008). Crops that had multiple markets such as corn for grain and silage were separated and summed for the total acreage by the various crop markets. The market-specific information about specific crops is used to create technical and economic effects across regions for the enterprise budgets in the economic optimization.

### 2.2.1 Cropping Systems: CAC acres by DPR sections

When the average annual CAC acreage data was tabulated by crop and county, total acreage was 1.14 million acres for the 14 northern California counties in the DPR dataset. Multiplying the 4,142 sections in the DPR dataset by 640 acres produces an acreage base of 2.65 million acres, or 2.3 times more land than was reportedly harvested annually. The county-level comparisons are presented in Figure 17. With increased cropping intensity within a county, the likelihood of partial-section inflation. This occurs in sections where less than the entire section is farmed. For example, on the perimeter of a growing area only a quarter section (160 acres) may be suitable for crop production. Within the DPR dataset that 640-acre section will show the crop activities for the 160-acre activities as 640 acres.

**Figure 17: Comparison of the acreage universe of the DPR and CAC datasets in the NCA Region**




The cropping pattern information developed in the 14 county, DPR data was expanded to the CAC historical data for the 29 counties in the northern California region. The multidimensional scaling and cluster analysis determined the cross-cluster relationships within each of the 14 counties in the northern California region of the DPR data. This county-specific cropping pattern data can be exported to non-DPR counties based on similar historical CAC cropping data. The cropping pattern/cluster information for the DPR northern California region data is summarized in Table 15.

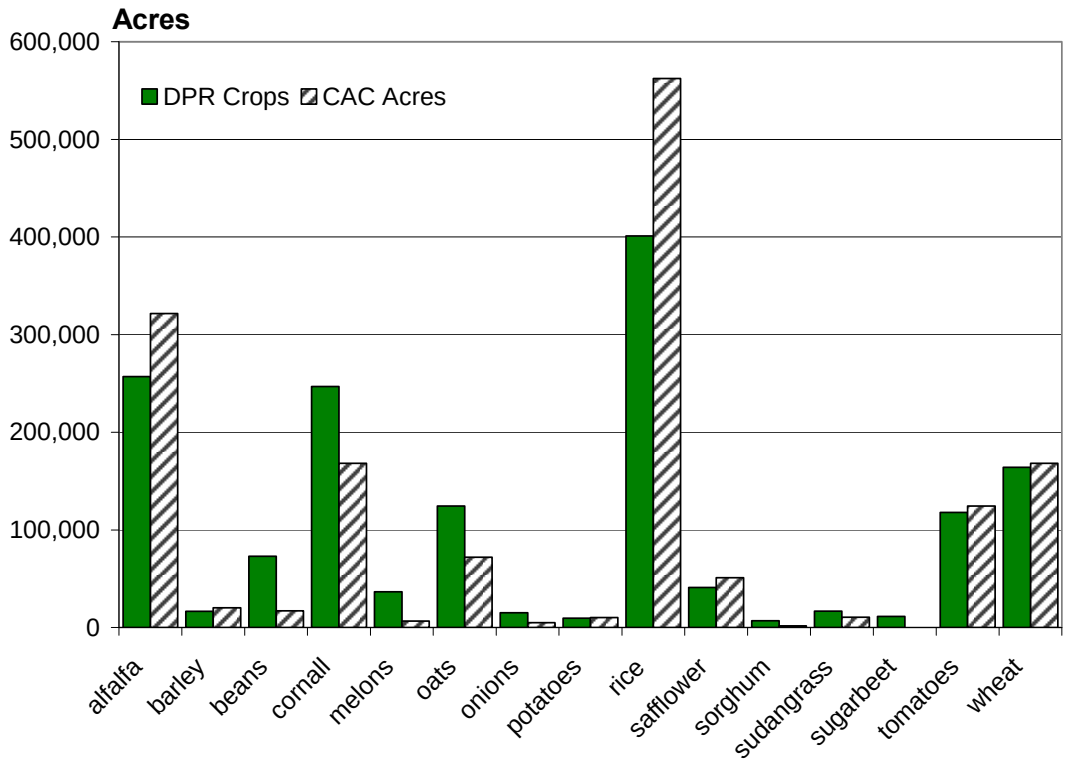
The cropping pattern data contained within specific clusters in each county served as proxies for the cropping pattern information in the non-DPR dataset counties within the region. The cluster information within each county must remain intact when exported to counties with similar crop production activities. The crop choice data contained within each cluster transcends the clusters. Each cluster contains inherent information on irrigation districts, water price, soil fertility, etc. The county-level information in Table 15 sums to 100 percent horizontally by row. The total cluster acres for all 29 counties in the region are reported in the last row.

**Table 15: Cropping pattern/cluster relationships contained within each county of the NCA Region**

| | CL 1 | CL 2 | CL 3 | CL 4 | CL 5 | CL 6 | CL 7 | CL 8 | CL 9 |
|---|---|---|---|---|---|---|---|---|---|
| **Amador** | 66.7% | | | 33.3% | | | | | |
| **Butte** | 30.6% | 0.2% | 53.8% | 3.1% | | 4.3% | | 7.66% | 0.2% |
| **Glenn** | 24.8% | 0.8% | 35.0% | 18.6% | 0.6% | 10.4% | 1.5% | 6.99% | 1.3% |
| **Humboldt** | 100.0% | | | | | | | | |
| **Lake** | 87.0% | | 4.3% | 8.7% | | | | | |
| **Lassen** | 57.6% | | | 42.4% | | | | | |
| **Placer** | 33.7% | | 65.2% | | | | | 1.12% | |
| **Sacramento** | 47.0% | 7.8% | 5.6% | 18.5% | 1.9% | 1.3% | 0.9% | 15.36% | 1.6% |
| **San Joaquin** | 33.0% | 10.7% | 1.1% | 22.7% | 3.4% | 1.1% | 0.2% | 15.13% | 12.6% |
| **Solano** | 36.5% | 8.2% | | 31.4% | 2.0% | | | 10.48% | 11.3% |
| **Sutter** | 15.4% | 1.2% | 41.4% | 4.1% | 3.2% | 8.1% | 21.9% | 4.54% | 0.2% |
| **Tehama** | 76.4% | 0.6% | 2.8% | 18.0% | | | | 2.25% | |
| **Yolo** | 22.5% | 16.6% | 11.3% | 13.9% | 4.3% | 7.0% | 4.3% | 5.53% | 14.5% |
| **Yuba** | 23.0% | | 72.4% | 1.3% | | 2.6% | | 0.66% | |
| **29-County Acres** | 476,419 | 82,923 | 332,849 | 261,446 | 33,975 | 68,550 | 95,470 | 109,203 | 78,148 |

The regional crop acreage using the DPR cropping patterns and CAC acreage (DPR crops) is compared with the historical (CAC) data only in Figure 18. This is a validation of the acres created by combining the DPR cropping pattern information to the CAC historical acreage. The solid green bars in Figure 18 are the model acreage compared with the straight historical CAC data in the cross-hatched bars. The model over-estimates beans, corn, melons, and oats, and under-estimates alfalfa and rice. But the fit is reasonable considering the DPR was only available for half of the counties in this northern region. The two datasets have 77 percent of maximum acres for each crop in common. The underlying acreage conversion values were estimated for each of the five regions.

**Figure 18: Comparison of modeled DPR acreage data with historical CAC data in the NCA Region**




## 2.3 Establishing Crop Enterprise Budget Data

Budgets were developed for each of the 24 crops in the DPR data. Enterprise budgets, whether derived from individual farm data or by the teams of experts assembled for the UC-Davis, Cost and Return Studies are standardized for the time and location-specific components. The budgets were adjusted for price levels and regional economic and technical effects are being incorporated into the budgets.

### 2.3.1 Enterprise Budgets for Historical Cropping Systems

Table 16 illustrates the preliminary sources for the enterprise budgets included in this economic optimization. The five regions are Northern California (NCA), the Central Region (CEN, Northern San Joaquin Valley), Southern San Joaquin Valley (SSJ), Southern California (SCA, Riverside and Imperial Counties), and the Central Coast (COA). The three principal sources were current UC-Davis, Cost & Return Studies (X), archived C&RS (O), and farmer-interview data (I) (UC-Davis. 2010)

The foundation for the economic enterprise budgets is the UC-Davis Cost and Return Studies (C&SR). These enterprise budgets are rigorously established to represent realistic economic costs of each commodity they represent. The objective of the C&RS however is not the same as the purpose grown crop modeling that is underway at the California Biomass Collaborative (CBC) in partnership with the Bren School. Therefore some of the fixed cost assumptions have

been modified. The CBC model value only works effectively if all the different crops within each cropping system cluster (Department of Pesticide Regulation, DPR) and across all growing regions within California are tuned together. **The CBC model works most effectively on relative changes rather than absolute changes.** Therefore a number of assumptions and 'adjustments' in the C&RS budgets have been relaxed to permit the budgets to be equitable across the state and to interact appropriately across regions.

**Table 16: Economic information sources for bioenergy crop enterprise budgets**

| | NCA | CEN | SSJ | SCA | COA |
|---|---|---|---|---|---|
| Alfalfa | X, I | X, I | X, I | O | O |
| Barley | I, O | I, O | O | | O |
| Beans | I, O | X | X | | O |
| Bermudagrass | | | | X | |
| Broccoli | | | | X | X |
| Carrots | | | | X | O |
| Corn | X, I | X, I | X | X | O |
| Cotton | I, O | I, O | I, O | X | |
| Forage Grasses | X, I | O | O | | X |
| Garlic | I | I | O | | O |
| Lettuce | | | | X | X |
| Melons | | I | | X | |
| Oats | X | | | | O |
| Onion | X | | X | X | |
| Potato | X | O | | O | O |
| Rape | | | | | |
| Rice | X, I | X | O | | |
| Ryegrass | | | | X | |
| Safflower | X, I | O | O | | |
| Sorghum | | | X | O | |
| Sudangrass | I, O | | X, I | X | |
| Sugarbeet | O | I, O | O | X | O |
| Tomato | X, I | X, I | X | | O |
| Wheat | X, I | I, O | X, I | X | O |

*X = Cost & Returns Study, Since 2000*
*I = California Biomass Collaborative Farmer-Interview*
*O = Older Cost & Returns Study, Before 2000*

Adjustments:

- Relaxation of "economic costs"
  - Economic costs include variable and fixed costs. The goal is to develop realistic metrics for comparison of alternative use of capital (opportunity costs). It is not uncommon to have negative enterprise budgets. When all the fixed costs are accounted for, many crops will not provide a return that will justify investing in the capital required to produce these crops. There are numerous reasons why this occurs. Some are economic (it is better to partially utilize some resources so they can be provide a greater return for other enterprises in the system). Some may not be economic (i.e., "It is what has always been done"). For the purposes of the C&RS, it

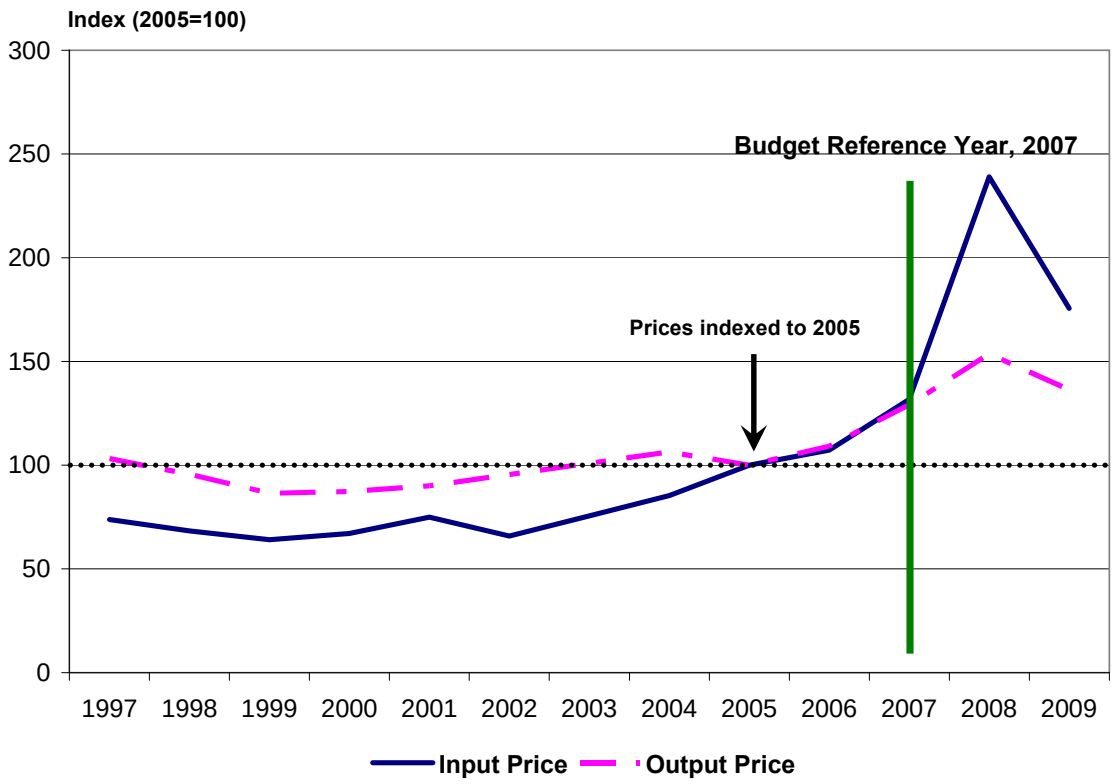
is accurate to develop realistic budgets that produce negative profits for some crop enterprises.

- The goal of this project is not to determine if farm capital could be better used in non-farm investments. This project targets the relative changes in existing crop production systems. This is a different question/challenge. Reflecting negative economic costs for specific crop production activities will simply drop them from the model (even though for non-economic cost reasons, the negative-return crops are still being produced in California). Therefore crops that are grown in California will all have non-negative crop values in this relative cropping system model. **Every crop that has a negative return in the final per-acre profit estimate is set to a value of $5 profit per acre to keep it in the model until a crop of higher value replaces it.**

- Adjustment for time-dependent price levels
  - USDA ERS has indexed fertilizer costs as well as farm output prices (Figure 19)[1]. These indices are used to adjust various C&RS budgets to the cost of living, price level adjustments for the year in which each budget was created. Individual year budgets were adjusted up or down relative to the year. Initially the base year was set to 2005, but it became apparent that this was too low. The Budget reference year for the current CBC cropping model is now 2007. This allows the budgets to be 1) standardized across the system, and 2) to capture prices and costs that do not reflect the economic shock of the 2008-2009 sudden oil price increase and recent recession.
  - It should also be noted that all crop and input prices and costs have been set to 2007 price levels. When costs and revenues from 2007 are compared to current values, the current prices will be inflated compared to the model 2007 prices. The comparison will not be an 'apples to apples' comparison, unless the current prices are deflated to 2007 levels also.

[1] USDA Economic Research Service, Fertilizer Use and Price Data from 1960-2009. http://www.ers.usda.gov/Data/FertilizerUse/. Table 8 – Fertilizer price indexes, 1960-2009p, includes fertilizer cost indices and crop output indices. The fertilizer costs were assumed to be a proxy for all crop input prices. Non-energy derived costs will be lower, while some fossil-fuel derived costs will likely be higher.

**Figure 19: Price level adjustments for analysis enterprise budgets**




- Adjustment for regional yield, price and input cost effects
  - ***Revenue Indices:*** The California Agricultural Commissioner data (CAC) has been summarized and tabulated for the production years 2004-2008. These summaries include county-level yield and price estimates. These 5-year summaries are aggregated for each region to establish regional differences. For each crop, the region with the most representative and complete enterprise budget is used as the base index reference region (the index denominator). ***Yield*** and ***price*** are adjusted to an index value of 1.0. The other regional yields and prices are either higher or lower than 1.0. Each region is then indexed based on real historical data.
  - ***Cost Indices:*** Regional adjustments on production costs were indexed with ***water prices/costs*** and ***land rental values***. The highest price for water occurred in the south San Joaquin Valley. The highest amount of water used was in the Imperial Valley region, and the highest land rental rates occurred along the coast of California.

- While every budget followed this protocol initially, when unusual numbers occurred more information was sought from farm advisors and crop scientists to get better values.

The protocol for establishing/tuning multiple crops within local cropping systems (DPR clusters) with similar and different crops across California production regions is as follows:

1. Build appropriate crop budget based on UC-Davis C&RS.
2. Adjust/Standardize values across time to 2007 output prices and input costs.
3. Adjust/Standardize values across region based on historical differences in yield and output prices described in the CAC county-level data.
4. Assign a per-acre profit of $5 per acre for any crop that is already being grown in California. This allows currently grown crops to remain in the model until an alternative of higher value appears.

Table 17 illustrates the list of over 90 regionally-specific crop enterprise budgets developed for this analysis.

**Table 17: Crops for which regionally-specific enterprise budgets were created**

| | NCA | | CEN | SSJ | SCA | COA |
|---|---|---|---|---|---|---|
| | SAC | Inter-MT | | | | |
| Alfalfa | B | B | B | B | B | B |
| Barley | B | | B | B | B | B |
| Beans | B | | B | B | B | B |
| Bermudagrass | | | | | B | |
| Broccoli | | | B | | B | B |
| Carrots | | | | B | B | B |
| Corn Grain | B | | B | B | | B |
| Corn Silage | B | | B | B | B | |
| Sweet Corn | | | | | B | B |
| Cotton | | | B | B | B | |
| Forage Grasses | | | | | | B |
| Garlic | | | B | B | | B |
| Lettuce | | | B | B | B | B |
| Melons | B | | B | B | B | B |
| Oats | B | | B | B | B | B |
| Onion | B | B | B | B | B | B |
| Potato | B | | | B | B | B |
| Rice | B | | B | | | |
| Wild Rice | | B | | | | |
| Safflower | B | | | B | | B |
| Sorghum | B | | | | | |
| Sudangrass | B | | | | B | |
| Sugarbeet | B | | B | B | | |
| Tomato | B | | B | B | B | B |
| Wheat | B | | B | B | B | B |

***B = Regionally-specific crop budget developed.***

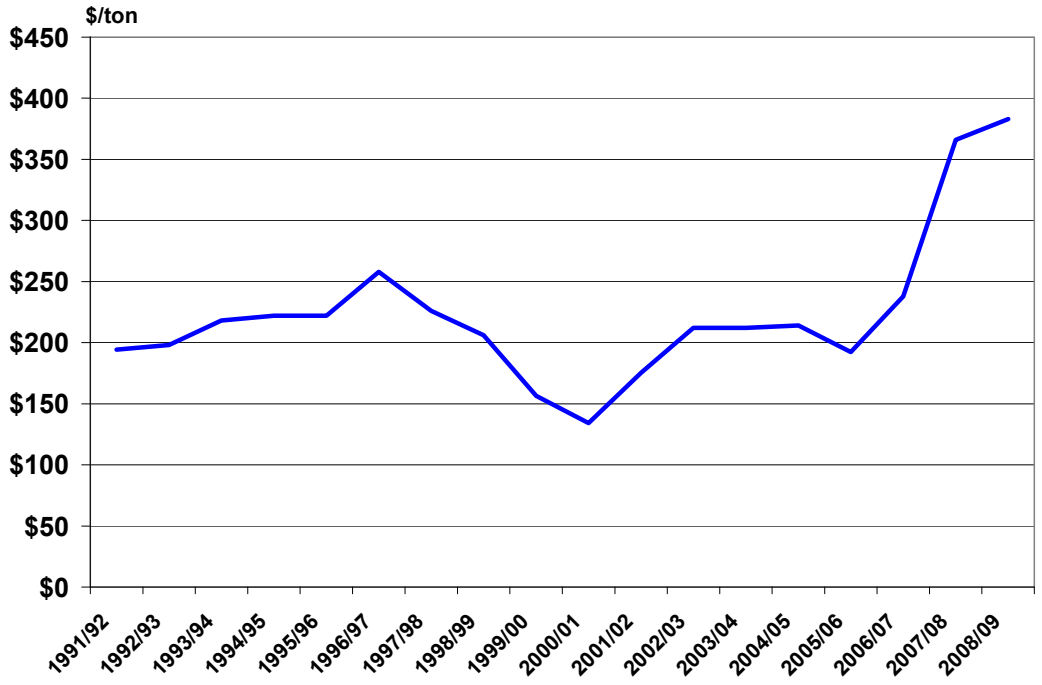
### 2.3.2 Energy Crop Enterprise Budgets

Five energy crops were examined: canola, sweet sorghum, sugarbeets, safflower, and bermudagrass. The first two: canola, a winter annual oilseed crop, and sweet sorghum, a summer annual grass sugar and fiber crop; currently are not commercially produced in California. The other three: sugarbeets, safflower, and bermudagrass; are all currently commercially produced in the state. The currently grown crops relied on budgets developed for existing cropping systems. Commercial production budgets were constructed for canola and sweet sorghum. The base crop used for canola was wheat, but information from safflower production was also studied. Water use and crop timing were based on wheat. Yield variation across California was based on limited yield trials and professional experience (S. Kaffka, unpublished). The base crop for sweet sorghum was corn silage. Professional judgments were made based on limited field trials and the variation in crop habit from corn silage. For both canola and sweet sorghum, conservative values were used for yields.

The market price of canola, $320/ton, was used as a base price in the analysis. This compares with upward pressure on vegetable oil and prices above $360/ton reported by USDA the last 2

production years Figure 20. Sweet sorghum prices more closely reflected corn silage prices than other crops.

**Figure 20: US Canola prices ($/ton, USDA)**




## 2.4 Regional Economic Biofuel Crop Optimization

The PMP profit optimization model is ideally adapted for the regional, multi-crop, crop cover modeling using the DPR data (Howitt, 1995). Existing crops in the cropping rotation are constrained by the opportunity cost of adopting the next additional unit of production. These marginal opportunity coefficients are created for the crops currently in production and the energy production is not currently a production objective.

The new crop alternatives are lured into the model by holding the non-linear coefficients of the existing cropping system constant while incrementally increasing the revenue for the energy crops. The new (bioenergy) crop alternative is typically a linear form of the 'profit = (revenue – cost)' equation. This can cause some distortion in the extremes, but was generally considered to represent the seasonal crop selection activities.

For the energy crops that are already in production: bermudagrass, sugarbeets, and safflower; there was no linear component. The revenues were adjusted by incrementally increasing the output price for the energy crop. The PMP function does not operate correctly unless the all of the original crops are used as input information in the optimization model.

The LP model, the PMP/calibration model, and the functional form model (used in the analysis) are presented below.

### 2.4.1 The LP Model

$$\underset{A_{i,g}}{\text{Max}} \sum_{i} \sum_{g} \left[ P_{i,g} Y_{i,g} - \sum_{j} C_{i,j,g} \right] \text{A}_{\text{i,g}}$$

Subject to $\sum_{i} (\alpha_{\text{i,g,j}} * \text{A}_{\text{i,g}}) \le \bar{R}_{g,j}$ resource constraint ($\lambda_1$)

$\text{A}_{\text{i,g}} \le \bar{\text{A}}_{i,g} \times (1+\varepsilon)$ calibration constraint ($\lambda_2$)

where: $A_{i,g}$ = acres of crop *i* in region *g*

$P_{i,g}$ = farm price of crop *i* in region *g*

$Y_{i,g}$ = yield of crop *i* in region *g*

$C_{i,j,g}$ = cost per acre of crop *i* in region *g* from input *j*

$\alpha_{i,g}$ = per acre intensity of resource *j* for crop *i* in region *g*

$\bar{A}_{i,g}$ = observed acreage of crop *i* in region *g*

$\bar{R}_{g,,j}$ = acres of crop *j* in region *g*

$\varepsilon$ = perturbation

*j* = land and water

### 2.4.2 The Calibrated, PMP Model

$$\underset{X_{g,i,j}}{Max} \sum_{g} \sum_{i} \left[ P_{g,i,j} Y_{g,i,j} X_{g,i,j} - \left( \sum_{j} \left( C_{g,i,j} X_{g,i,j} \right) + \frac{1}{2} \gamma_{g,i,A} X^{2}_{g,i,A} \right) \right]$$

Subject to $\sum_{i} \text{X}_{\text{j,i,g}} \le \bar{\text{R}}_{\text{j,g}}$ j = A (land), w (water)

$P_{g,i,j}$ = farm price of crop *i* in region *g*

$Y_{g,i,j}$ = yield of crop *i* in region *g*

$\bar{R}_{g,,j}$ = acres of crop *j* in region *g*

$X_{g,i,j}$ = level of input *r* applied in region *g* for crop *i*

$\gamma_{\text{A,g,i}}$ = coefficient of quadratic cost

### 2.4.3 The Functional Form of the Model

**Production function**

$$\underset{X_{e,g,i,j}}{Max} \sum_{g} \sum_{j} \left[ \begin{array}{l} \left\{ \sum_{i} \left( P_{g,i,j} \times \left( \beta_{g,i,j} - \omega_{g,i,j} X_{g,i,j} \right) - C_{g,i,j} \right) X_{g,i,j} \right\} \text{ PMP function} \\ \left\{ + \sum_{e} \left( P_{e,g,j} Y_{e,g,j} - C_{e,g,j} \right) X_{e,g,j} \right\} \text{ Energy crop function} \end{array} \right]$$

Subject to: $\sum_{i} \sum_{e} X_{g,i,e,j} \le \overline{R_{g,j}}$ *j= {A(acres), w(ac-ft of water)}*

$P_{e,g,i,j}$ = farm price of crop *i*, and energy crop *e*, in region *g*, and resource, *j*.
$Y_{e,g,i,j}$ = yield of crop, *i*, and energy crop *e*, in region, *g*, and resource, *j*.
$\overline{R}_{g,j}$ = acres of crop *j* in region *g*.
$X_{e,g,i,j}$ = level of input *r* applied to energy crop e, in region *g* for crop *i*.
$\beta_{g,i,j}$ = intercept of the quadratic (marginal) curve of crop, *i*, in region, *g*, resource, *j*.
$\omega_{g,i,j}$ = slope of quadratic (marginal) curve of crop, *i*, in region, *g*, and resource, *j*.

### 2.4.4 Maximizing Profit vs. Optimizing Yield, Output Price, and Input Costs

It is common in bioenergy supply and demand discussions to discuss the components of profit: yield, output price, and input costs. This analysis, however, maximizes profit, which is an aggregate of those three factors. There is a direct relationship between change to yield and price, and a change in profit (same sign). There is an inverse relationship between change to input costs and profit (opposite sign). Therefore there is a need to discuss the results in terms of a change in profit rather than the individual factors of yield, price and cost.

Profit is equal to the revenue minus the costs ($\pi = R - C$). The revenue is the output price, **P**, times the yield, **Y**. For each crop these are summed across all outputs (grain + straw, cotton lint + cotton seed, etc.). In this model, all these values reflect a 'per-acre' basis.

$$\pi = \sum_i (P_i * Y_i) - C \quad \textit{where } i = \textit{individual outputs}$$

In this model it is easy to independently change **P**, **Y**, or **C**, holding the other factors constant. This shows the role each independent component plays on the profit. In real life, all three of these factors are changing at the same time. Table 3.9 illustrates different ways to achieve an incremental 10 percent increase in profit. The first three examples adjust price, yield, and cost independently to achieve a $34 increase in profit. Example 3, in Table 18, shows a 10 percent decrease in input costs, which have the same effect as either a 10 percent increase in price or yield (Examples 1 & 2).

**Table 18: Relationship between canola price, yield, and input cost**

| Example | Profit | Price | Yield | Cost |
|---|---|---|---|---|
| default | $0 | 340 | 1 | 340 |
| | | +10% | | |
| 1 | $34 | 374 | 1 | 340 |
| | | | +10% | |
| 2 | $34 | 340 | 1.1 | 340 |
| | | | | -10% |
| 3 | $34 | 340 | 1 | 306 |
| | | + 9.5% | + 9.5% | +10% |
| 4 | $34 | 372.3 | 1.096 | 374 |
| | | + 13% | + 15% | +20% |
| 5 | $34 | 384.2 | 1.15 | 408 |

Since canola and sweet sorghum do not have a history of commercial production in California, there is considerable uncertainty about the actual values. The component that can easily be inferred from other regions is the output price, P. The yield under commercial production can be considerably more variable than those conducted under structured research conditions. Also the costs of crop production in other states and countries are commonly much different than in California.

In this analysis the sensitivity analysis has been conducted on profit, π. In the initial conditions canola and sweet sorghum are set to a profit = $0 (Revenue = Costs). This makes some intuitive sense in that if these crops were profitable now, they would already be in commercial production. By holding cost and yield constant, incremental increases in the output prices will reflect changes in profit.

The interpretation of incremental shifts in profit of $20/acre and $40/acre is less straight-forward. The incremental shift in profit is the result of changes in P, Y, and C; at the same time.

Canola and sweet sorghum have different profit structures. A 10 percent increase in profit for canola, as entered in the initial model level, is $34/acre. For sweet sorghum a 10 percent increase in profit, at the initial levels of $26/ton and 30 tons/acre, is $78/acre. Comparison of a 10 percent increase in profit, revenue, and costs, for these two crops creates a lop-sided comparison.

To overcome this profit percentage-bias between crops and facilitate the comparison of a producer's next incremental source of potential profit, marginal profit level increases of $20/acre and $40/acre were considered. This increased profit represents a long-run average increase, not a seasonal, one-time increase. This long-run average profit designation redirects the results to the net benefit and away from the individual causal effects of P, Y, and C. Table 19 illustrates how simultaneous shifts in P, Y, and C will influence canola profit per acre. The **bold values** indicate the default levels of P, Y, and C, of $340/ton, 1 ton/acre, and $340 per acre of input costs, respectively. The first four examples or scenarios show negative profit (red text). These are caused by P, Y, and C, which were lower than the entry level values. As P, Y, and C levels increase, profit becomes positive (green text). The next group of four examples indicates the dynamics of profitable combinations. The last two examples show that it is not unreasonable to have significantly higher profits if all three components are moving in the same direction.

**Table 19: Variations in the per-acre profit from canola**

| Example | π | = ( P | * | Y ) | - | C |
|---|---|---|---|---|---|---|
| **1** | ($96.00) | $330 | | 0.8 | | $360 |
| **2** | ($78.00) | **$340** | | 0.8 | | $350 |
| **3** | ($34.00) | **$340** | | 0.9 | | **$340** |
| **4** | ($14.00) | **$340** | | 0.9 | | $320 |
| **5** | $14.00 | $360 | | 0.9 | | $310 |
| **6** | $16.00 | $360 | | 1.1 | | $380 |
| **7** | $20.00 | $350 | | **1** | | $330 |
| **8** | $37.50 | $350 | | 1.25 | | $400 |

| | | | | |
|---|---|---|---|---|
| **9** | $102.00 | $360 | 1.2 | $330 |
| **10** | $210.00 | $360 | 1.5 | $330 |

### 2.4.5 Optimization

The PMP model requires the cropping system to be calibrated initially. The PMP production function intercept, $\beta$, and slope, $\omega$, are then calculated from the shadow values of the base system.[2] This allows the acreage values for each crop to vary with a change in price, while holding the marginal values of the base system constant. The non-linear curvature adds flexibility to the straight linear, non-PMP, function.

Once the cropping system model PMP coefficients were established, incremental increases in profit were optimized by adjusting the output price at specified increments. The model structure allows the output price and the input costs to be varied. Yield values are replaced with the PMP production function. Table 20 contains the input factors for the Cropping System/Cluster 1 in the Northern California (NCA) Region as an example. For illustration purposes the profit of each crop is also presented in the table.

**Table 20: Input factors: yield, price, cost, acres, & water; for Cluster 1, NCA Region**

| CL1 | Yield | Unit | Price/unit | InputCosts | Acres | Water | Profit |
|---|---|---|---|---|---|---|---|
| Alfalfa | 6.33 | tons | $164.30 | $685.43 | 52,939 | 3.19 | $355.15 |
| Barley | 2.26 | tons | $176.93 | $374.93 | 13,261 | 0.00 | $24.14 |
| Beans | 1.25 | tons | $655.38 | $788.24 | 29,863 | 2.67 | $30.99 |
| Corn-grain | 5.50 | tons | $140.04 | $706.56 | 131,042 | 3.18 | $63.66 |
| Melons | 680 | boxes | $2.46 | $1,387.00 | 15,036 | 1.5 | $284.88 |
| Oats | 2.6 | tons | $134.21 | $335.91 | 88,336 | 0.00 | $19.09 |
| Onions | 458.04 | cwt | $10.69 | $3,528.76 | 7,414 | 2.92 | $1,369.09 |
| Potatoes | 20.00 | tons | $126.04 | $2,307.30 | 7,622 | 2.67 | $213.41 |
| Rice | 83.00 | cwt | $15.50 | $1,181.23 | 14,688 | 4.25 | $105.27 |
| Wildrice | 0.75 | tons | $1,264.39 | $908.24 | 7,344 | 4.17 | $40.05 |
| Safflower | 1.20 | tons | $361.45 | $366.08 | 10,755 | 0.50 | $67.67 |
| Sudangrass | 5.25 | tons | $142.00 | $725.00 | 16,915 | 2.33 | $20.50 |
| Tomatoes | 35.00 | tons | $58.82 | $1,864.37 | 16,707 | 3.50 | $194.21 |
| Wheat | 3.00 | tons | $156.20 | $434.36 | 64,499 | 0.50 | $34.24 |

Table 21 shows the crop-timing factors for Cropping System/Cluster 1 in the NCA Region. The '1' indicates when the crop is being grown in the field. The '0' indicates the field is not in production. A complete list of crop input factors is provided in Appendix C.

**Table 21: Crop-timing factors for Cropping System/Cluster 1, in NCA Region**

[2] Shadow prices reflect the marginal or opportunity cost utilizing the next available unit. The PMP model converts these opportunity costs into a quadratic function that preserves core relationship information within the system as new crops are introduced.

| CL1 | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alfalfa | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Barley | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| Beans | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| Corn-grain | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| Melons | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| Oats | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| Onions | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 |
| Potatoes | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| Rice | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| Wildrice | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Safflower | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| Sudangrass | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| Tomatoes | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| Wheat | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |

Tables 22 and 23 provide the input factors for the five energy crops considered in this analysis. Canola and Sweet Sorghum are not currently grown commercially in California, while the other three crops are currently grown in various locations.

**Table 22: Model input factors for the energy crops in Region NCA**

| NCA-Energy | Yield | Unit | Price/unit | InputCosts | Acres | Water |
|---|---|---|---|---|---|---|
| Canola | 1.00 | tons | $340.80 | $340.80 | --- | 0.50 |
| Sweet Sorghum | 32.00 | tons | $26.00 | $832.00 | --- | 2.00 |
| Safflower | 1.20 | tons | $361.45 | $433.75 | --- | 0.50 |
| Sugarbeet | 30.00 | tons | $37.80 | $1,134.00 | --- | 3.00 |
| Bermudagrass | 3.20 | tons | $170.00 | $554.75 | --- | 4.00 |

**Table 23: Model crop-timing input factors for the energy crops in Region NCA**

| NCA-Energy | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Canola | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| Sweet Sorghum | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| Safflower | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| Sugarbeet | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| Bermudagrass | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

# CHAPTER 3:
# Results

The results reflect changes in the 45 cropping pattern clusters from an iterative increase in the profit of the five energy crops examined: canola, sweet sorghum, sugarbeets, safflower, and bermudagrass. Profit represents the net effects of yield, output price, and input costs. The profit also represents a long-term average rather than a seasonal price. This profit is the kind of practice-altering influence that pulls farmers away from their traditional cropping patterns with confidence that the economic risks are low.

The prices were indexed to reflect the price levels of 2007. A greater priority was placed on the inter-regional relationships than on the absolute price levels. Price levels will change over time, but price differences between regions will likely change less. The subsequent use of different prices and yields will produce different results.

## 3.1 Cropping Pattern Clusters within the Region

The GAMS computer software generated many numbers as requested. By the end of the analysis it was optimizing over 40 profit iterations for each cropping pattern, and produced an acreage-change table as well as a table for changes in water-use. The output of the incremental price increases for each cropping pattern cluster was summarized for each of the five energy crops at the $20/acre profit increase and the $40/acre profit levels.

The initial aggregation process is presented for cropping pattern Cluster 7 in the Northern California Region (NCA). Table 24 shows a change in the canola profit, $/acre (first column), in $5/acre increments. Canola profit/acre and price/ton are directly related because the yield was set at 1.0 ton/acre and the input costs are held constant at $340/acre, which is the price at which canola entered the model. In the case of the energy crops, they always begin the model run at or below $0 profit. This means at current conditions they will not enter the model. As the price iterates to a higher profit level, they will begin to enter the model. For reference, the incremental canola price is posted in column two.

**Table 24: Change in acres for an incremental increase in canola price for Cropping System/Cluster #7 in the NCA Region**

| Increased Profit ($/ac) | Price $/ton | Alfalfa Acres | Dry Bean Acres | Corn Acres | Melon Acres | Rice Acres | Safflower Acres | Tomato Acres | Wheat Acres | Canola Acres |
|---|---|---|---|---|---|---|---|---|---|---|
| $0 | $340 | 2,293 | 10,513 | 5,379 | 9,670 | 30,539 | 9,700 | 16,695 | 10,681 | |
| $5 | $345 | 2,293 | 10,513 | 5,379 | 9,670 | 30,539 | 9,700 | 16,695 | 10,681 | |
| $10 | $350 | 2,297 | 9,153 | 5,459 | 9,637 | 31,216 | 9,434 | 16,766 | 10,045 | **1,463** |
| $15 | $355 | 2,302 | 7,148 | 5,577 | 9,589 | 32,214 | 9,042 | 16,871 | 9,105 | **3,621** |
| $20 | $360 | 2,308 | 5,143 | 5,696 | 9,540 | 33,213 | 8,650 | 16,975 | 8,166 | **5,779** |
| $25 | $365 | 2,314 | 3,138 | 5,814 | 9,491 | 34,211 | 8,258 | 17,080 | 7,227 | **7,937** |
| $30 | $370 | 2,320 | 1,133 | 5,933 | 9,443 | 35,210 | 7,866 | 17,184 | 6,288 | **10,095** |
| $35 | $375 | 2,314 | | 5,652 | 9,367 | 34,689 | 7,474 | 17,047 | 5,348 | **13,579** |
| $40 | $380 | 2,300 | | 5,149 | 9,277 | 33,323 | 7,082 | 16,775 | 4,409 | **17,155** |
| $40 | $40 | 8 | (10,513) | (230) | (394) | 2,784 | (2,618) | 80 | (6,272) | **17,155** |

The subsequent columns to the right of the second column in Table 4.1 indicate the optimal acres for each crop at the canola price in the second column. In this table, canola production first appears at $10/acre profit (row 3), utilizing 1,463 acres. At $40/acre profit level, canola production has increased to 17,155 acres. The very last row of the table presents the differences between the values at $0/acre and $40/acre profit. The reductions are shown in red and parentheses. Dry beans decreased by 10,513 acres, while rice production increased by 2,784 acres. As the lower valued crops dropped out (like dry beans), their water use was available for the production of higher valued irrigated crops like rice.

Table 25 is a similar table for cropping pattern Cluster 7 in the Northern California (NCA) Region, but indicates water use in acre-feet, instead of acres. The last row also shows the difference between the change in water-use from $0/acre and $40/acre profit. Canola water-use increased by 8,577 acre-feet, while dry bean water-use decreased by 28,034 acre-feet.

**Table 25: Change in acre-feet (ac-ft) of water for an incremental increase in canola price for Cropping System/Cluster #7 in the NCA Region**

| Increased Profit | Canola Price | Alfalfa Ac-ft | Dry Bean Ac-ft | Corn Ac-ft | Melon Ac-ft | Rice Ac-ft | Safflower Ac-ft | Tomato Ac-ft | Wheat Ac-ft | Canola Ac-ft |
|---|---|---|---|---|---|---|---|---|---|---|
| $0 | $340 | 8,311 | 28,034 | 17,087 | 14,505 | 129,791 | 4,850 | 58,433 | 5,341 | |
| $5 | $345 | 8,311 | 28,034 | 17,087 | 14,505 | 129,791 | 4,850 | 58,433 | 5,341 | |
| $10 | $350 | 8,325 | 24,409 | 17,342 | 14,456 | 132,668 | 4,717 | 58,681 | 5,022 | 732 |
| $15 | $355 | 8,346 | 19,062 | 17,718 | 14,383 | 136,911 | 4,521 | 59,047 | 4,553 | 1,811 |
| $20 | $360 | 8,368 | 13,715 | 18,094 | 14,310 | 141,155 | 4,325 | 59,413 | 4,083 | 2,889 |
| $25 | $365 | 8,389 | 8,368 | 18,470 | 14,237 | 145,398 | 4,129 | 59,779 | 3,613 | 3,968 |
| $30 | $370 | 8,410 | 3,021 | 18,846 | 14,164 | 149,642 | 3,933 | 60,145 | 3,144 | 5,047 |
| $35 | $375 | 8,387 | | 17,954 | 14,051 | 147,430 | 3,737 | 59,664 | 2,674 | 6,789 |
| $40 | $380 | 8,339 | | 16,357 | 13,915 | 141,623 | 3,541 | 58,713 | 2,205 | 8,577 |
| $40 | $40 | 28 | (28,034) | (730) | (590) | 11,832 | (1,309) | 280 | (3,136) | 8,577 |

Summaries for canola adoption in the NCA region at a $20/acre profit increase are presented in Table 26. From left to right are the crop names, the acreage changes for the region, and acreage changes for each cluster. The top row gives the total acres in the region and each cluster, while the bottom row gives the change in regional and cluster water use. Crops with a regional acreage increase are bolded. Decreased acres are shown in red in parentheses.

Table 27 presents the same acreage and water change information from a $40/acre increase in canola profit in the NCA region. In addition, the top row of Table 27 provides the acreage share per cluster. So for Cluster #1, (NCA-C1), the 476,419 acres represent 31 percent of the total 1,538,984 acres used in this analysis in the NCA region. While there was no decrease in water use at the $20/acre profit, water use declined significantly at the $40/acre profit with canola.

**Table 26: Net change in acreage by crop for a long-term, average $20/acre increase in canola profit in the NCA Region**

| 1,538,984 | Acres | 476,419 | 82,923 | 332,849 | 261,446 | 33,975 | 68,550 | 95,470 | 109,203 | 78,148 |
|---|---|---|---|---|---|---|---|---|---|---|
| Crop | NCA-ALL | NCA-C1 | NCA-C2 | NCA-C3 | NCA-C4 | NCA-C5 | NCA-C6 | NCA-C7 | NCA-C8 | NCA-C9 |
| Alfalfa | 80 | (125) | 0 | 0 | 0 | 0 | (5) | 17 | 0 | 194 |
| Barley | (873) | (873) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beans | (11,140) | (2,080) | 0 | 0 | 0 | 0 | (1,361) | (5,771) | 0 | (1,928) |
| Corn - Grain | (11,302) | (2,426) | 0 | (9,542) | 0 | 0 | (193) | 341 | 0 | 518 |
| Melons | (196) | (31) | 0 | 0 | 0 | 0 | 0 | (140) | 0 | (24) |
| Oats | (91,328) | (88,338) | 0 | 0 | 0 | 0 | (1,725) | 0 | 0 | (1,265) |
| Onions | (3) | (4) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Potatoes | (28) | (28) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rice | 10,219 | (166) | 0 | 6,809 | 0 | 0 | 702 | 2,873 | 0 | 0 |
| Wild Rice | (371) | (371) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Safflower | (1,785) | (90) | 0 | 0 | 0 | 0 | (146) | (1,128) | 0 | (420) |
| Sorghum | 301 | 0 | 0 | 0 | 0 | 0 | 0 | 301 | 0 | 0 |
| Sugarbeets | 253 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 253 |
| Sudangrass | (16,876) | (16,876) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tomatoes | 228 | (81) | 0 | 0 | 0 | 0 | (5) | 0 | 0 | 314 |
| Wheat | (9,752) | (1,758) | 0 | (1,459) | 0 | 0 | (1,157) | (2,703) | 0 | (2,675) |
| Canola | 132,585 | 113,248 | 0 | 4,202 | 0 | 0 | 3,892 | 6,210 | 0 | 5,032 |
| Ac-ft of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 27: Net change in acreage by crop for a long-term, average $40/acre increase in canola profit in the NCA Region**

| Cluster share of region | | 31.0% | 5.4% | 21.6% | 17.0% | 2.2% | 4.5% | 6.2% | 7.1% | 5.1% |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,538,984 | Acres | 476,419 | 82,923 | 332,849 | 261,446 | 33,975 | 68,550 | 95,470 | 109,203 | 78,148 |
| | NCA-ALL | NCA-C1 | NCA-C2 | NCA-C3 | NCA-C4 | NCA-C5 | NCA-C6 | NCA-C7 | NCA-C8 | NCA-C9 |
| Alfalfa | (3,068) | (1,519) | (109) | 0 | (1,414) | 0 | (77) | 5 | (13) | 59 |
| Barley | (16,757) | (13,262) | 0 | 0 | 0 | (349) | 0 | 0 | (3,146) | 0 |
| Beans | (71,375) | (28,312) | (5,188) | 0 | (7,745) | (4,372) | (1,361) | (10,513) | (9,398) | (4,487) |
| Corn - Grain | (50,576) | (29,479) | (1,291) | (9,542) | (5,179) | (531) | (660) | (330) | (3,062) | (502) |
| Melons | (1,338) | (573) | (69) | 0 | 0 | (57) | 0 | (412) | (155) | (72) |
| Oats | (124,461) | (88,338) | (2,350) | 0 | (23,076) | (698) | (3,953) | 0 | (3,320) | (2,727) |
| Onions | (76) | (53) | (6) | 0 | 0 | (4) | 0 | 0 | (9) | (3) |
| Potatoes | (439) | (386) | 0 | 0 | 0 | 0 | 0 | 0 | (53) | 0 |
| Rice | 8,471 | (1,628) | 0 | 6,809 | 0 | (6) | 817 | 2,511 | (31) | 0 |
| Wild Rice | (3,702) | (3,702) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Safflower | (9,555) | (2,318) | (779) | 0 | (1,003) | (382) | (350) | (2,696) | (1,024) | (1,004) |
| Sorghum | (1,254) | 0 | 0 | 0 | (961) | 0 | 0 | 26 | (319) | 0 |
| Sugarbeets | (4,611) | 0 | (630) | 0 | (2,439) | (173) | 0 | 0 | (759) | (610) |
| Sudangrass | (16,876) | (16,876) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tomatoes | (2,038) | (917) | (367) | 0 | (238) | (187) | (28) | 0 | (328) | 27 |
| Wheat | (114,032) | (45,196) | (9,790) | (4,325) | (16,524) | (5,138) | (2,765) | (6,460) | (17,442) | (6,392) |
| Canola | 411,699 | 232,559 | 20,578 | 7,068 | 58,577 | 11,897 | 8,379 | 17,870 | 39,059 | 15,711 |
| Ac-ft Water | (263,073) | (148,446) | (16,623) | 0 | (31,644) | (11,454) | 0 | (14,565) | (29,298) | (11,044) |

Canola acreage increased to 411,699 acres with large reductions in oats (124,461 acres) and wheat (114,032 acres). Dry edible beans and corn grain accounted for another 121,951 acres.

Areas such as NCA-C3 which is principally a rice production rotation saw limited changes in crop production.

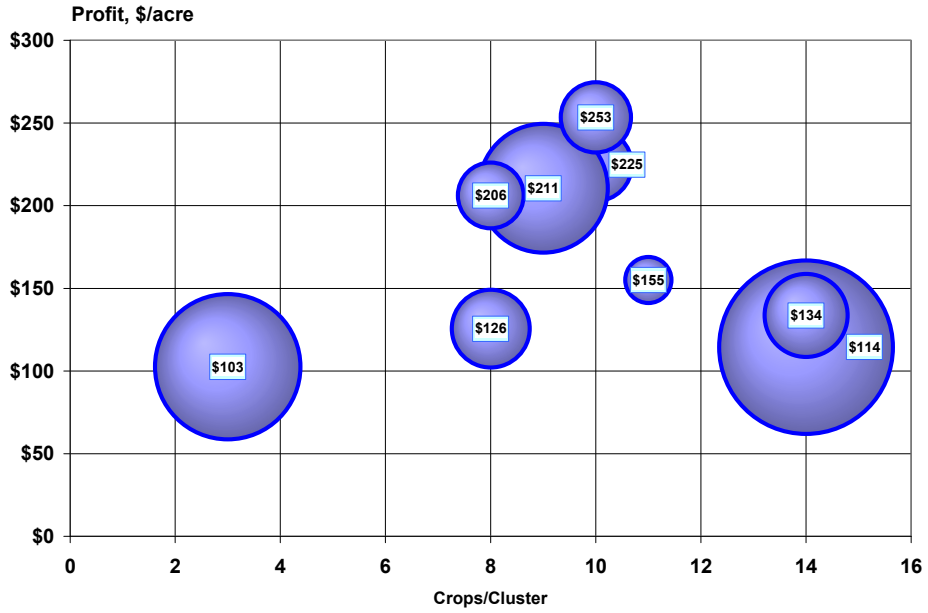
Because of the amount of data generated in each optimization, the results from the $20/acre and $40/acre bioenergy crop profit levels are presented in Appendix A. There are five sets of tables (one set for each energy crop) developed for each of the five regions. The activity in the Coastal Region was so small that safflower was the only crop that entered into a rotation and even so, that only took place in a single cluster.

## 3.2 Implications of a Relative Increase in Profit

The profit metric used in this analysis is a stable profit, rather than a volatile, random annual profit. An increase of $40 per acre profit indicates that the profit per acre will increase with certainty, or at the very least, with confidence. This can be interpreted as a certain contract price to produce an energy crop, or it could be a long-term, well-established, average price.

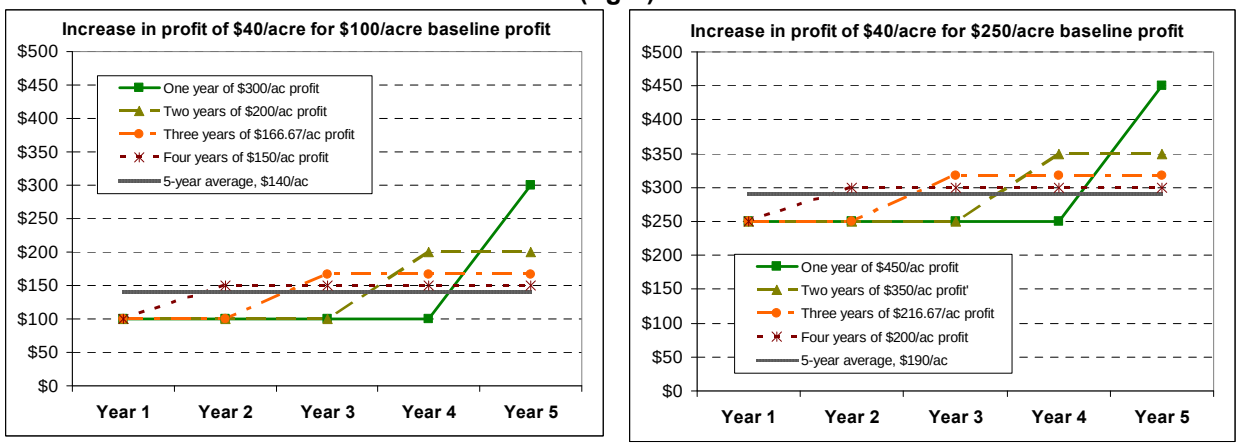
Figure 21 illustrates the average profit/acre ($/acre) of the 9 cropping system clusters in the Northern California (NCA) Region. Individual crop enterprise budgets for the NCA Region ranged from a low of $19 per acre for rain fed oat hay to a high of $1,370 per acre for irrigated onions. When the acreage and number of crops are included the cluster averages range from a low of $103/acre profit to a high of $253/acre. It is within this context that the relative increase of $40/acre for an energy crop is discussed. The size of each cluster bubble in Figure 21 is determined by the total cropping acres within each cluster.

**Figure 21: Average profit for all crops and acres of each Cropping System Cluster in Region NCA. Size reflects cropland acres in each cluster. For reference, the left-most, 3-crop, cluster contains 333,000 acres. The 11-crop, $155/acre average profit cluster contains 34,000 acres.**



A $40/acre increase on an average profit of $100/acre has a greater impact (larger influence) than a $40/acre increase on an average farm wide profit of $250/acre. A $140 profit/acre is a 40 percent increase over a $100/acre profit, while $290/acre is only a 16 percent increase in profit over the $250/acre profit. Figure 22 illustrates the challenge of raising average profit for these two baseline values by $40/acre.

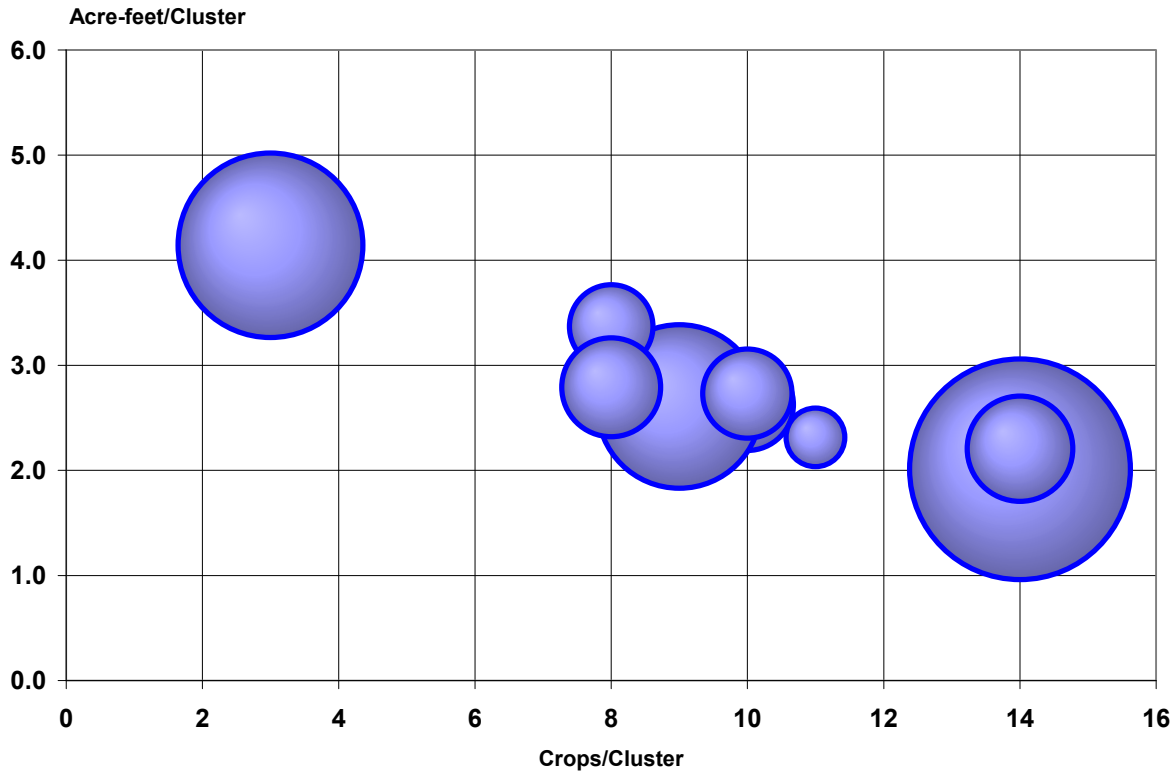
**Figure 22: Examples of annual profit increase required to shift a 5-year average profit up to a $40/acre from a base profit of $100/acre (left) and $250/acre profit (right).**




## 3.3 Cluster-specific canola adoption in the NCA Region

The Principal intent of this analysis was to develop data and a model framework that allowed the examination of local attributes on the decisions that farmers may make. Each cluster represents a farm or a cropping system and is based on historical data in California. Figure 23 shows the attributes of the 9 clusters in the NCA Region. These are: crop number, irrigation water in acre-feet, and the cluster acres relative to other clusters (bubble size). This figure compares directly with Figure 21. The only difference between the two figures is the vertical axis. Figure 23 highlights irrigation quantities in acre-feet of water, while Figure 21 indicates average profit per acre for each cluster.

**Figure 23: Attributes for the nine cropping clusters within the NCA Region: crop number, average acre-feet, and cluster size (bubble size in acres).**




The clusters have very different characteristics. Cluster 3 is the left-most bubble in Figure 23. It contains only 3 crops, but it has the highest water use (Nearly all rice production). On the right, Clusters 1 and 8 both have 14 crops, and both have the lowest water use - just over 2 acre-feet. Cluster 8 is the smaller bubble with just over 100,000 acres in it, while Cluster 1, the larger, right-most bubble, has nearly 500,000 acres.

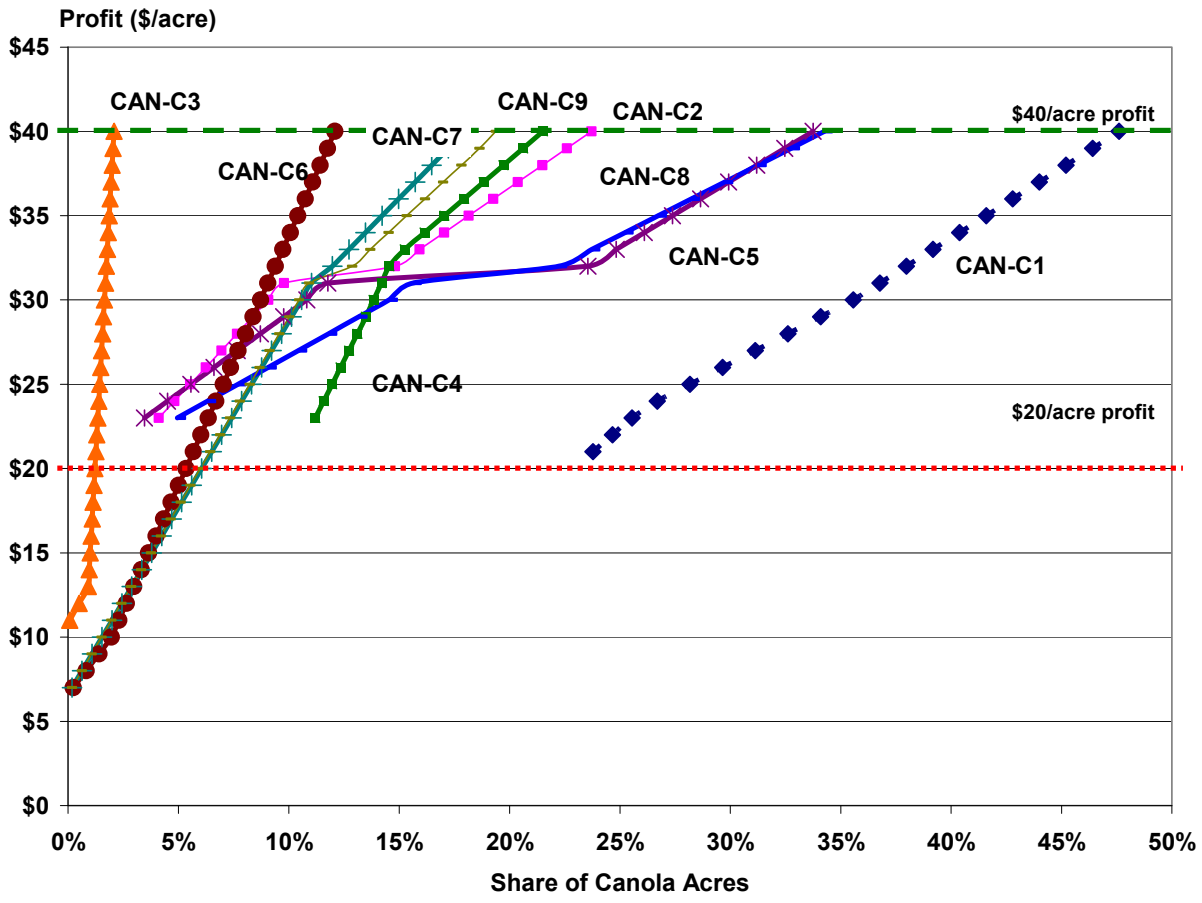
The other 7 clusters have 8 to 11 crops and all use between 2.3 and 3.4 acre-feet of water on average for all their crops.

### 3.3.1 Canola-Adoption Rates

The local effects between cropping pattern clusters within larger regions of the state are a compelling part of this analysis. Broader policy questions often call for better aggregate numbers for the states, but state-level values generally mask the details of local impacts. In Figure 24, the adoption levels of canola (share of canola acres/crop acres within the cluster) are

plotted below for all 9 clusters in the NCA region. Canola adoption behaves differently based on the collection of crops within each cropping pattern cluster, as well as the profit of each crop relative to the energy crop profit.

**Figure 24: Canola adoption based on price of canola and canola acreage share of the cluster in Region NCA**




Cluster 1, CAN-C1 is the cluster at the far right in Figure 24. It accounts for 31 percent (478,419 acres) of the regional 1,538,974 acres. Canola enters the C1 rotation at a price of $361/ton – just above the $20/acre profit level of $360/ton. Canola also enters C1 rotation at a canola acreage share of 23.8 percent, or at an acreage-level of over 113,000 acres.

Another significant cluster is CAN-C3. This canola price response curve is at the other extreme on the left-hand side of the chart. This crop cluster contains over 95 percent irrigated rice on 332,839 acres. Canola initially enters the cluster at $351/ton and at only 0.1 percent of the cluster acres in canola. The canola acreage in Cluster 3 never gets above 2.2 percent of the cropland acreage within the cluster. The slopes of the linear trend lines are provided in the right-hand column of Table 28. Cluster 3 has a slope of an $18-increase for every percentage of canola acres the cluster produces. When the canola acreage share increases by 2 percent the canola profit increases by $36/ton. This can be contrasted with the slope for Cluster 1 of $0.77 per increase in

canola share. From the time canola enters the rotation of Cluster 1 at $361/ton and reaches the $40/acre profit of $380/ton, the share of canola acres increases from 23.8 percent to 47.6 percent.

The other cluster of significant size is Cluster 4. Canola enters the rotation at a price of $363 and an acreage share of 11.2 percent. It has a relatively steep slope of $1.61/ton per increase in canola acreage share. These different slopes and entry levels are all determined by the characteristics of each cluster related to profit/acre of each crop, total acres and timing of each crop, and water levels of crop. Cluster CAN-C1 has the greatest variety of crops and variety of crop profits. CAN-C3 has almost no variability in crops or crop profits, so as long as rice profit is greater than canola, canola does not enter the Cluster 3 rotation.

There three clusters: C1, C3, and C4; account for 70 percent of the 1.5 million acres of cropland in this NCA Region.

**Table 28: Selected cluster properties of canola adoption in the NCA Region**

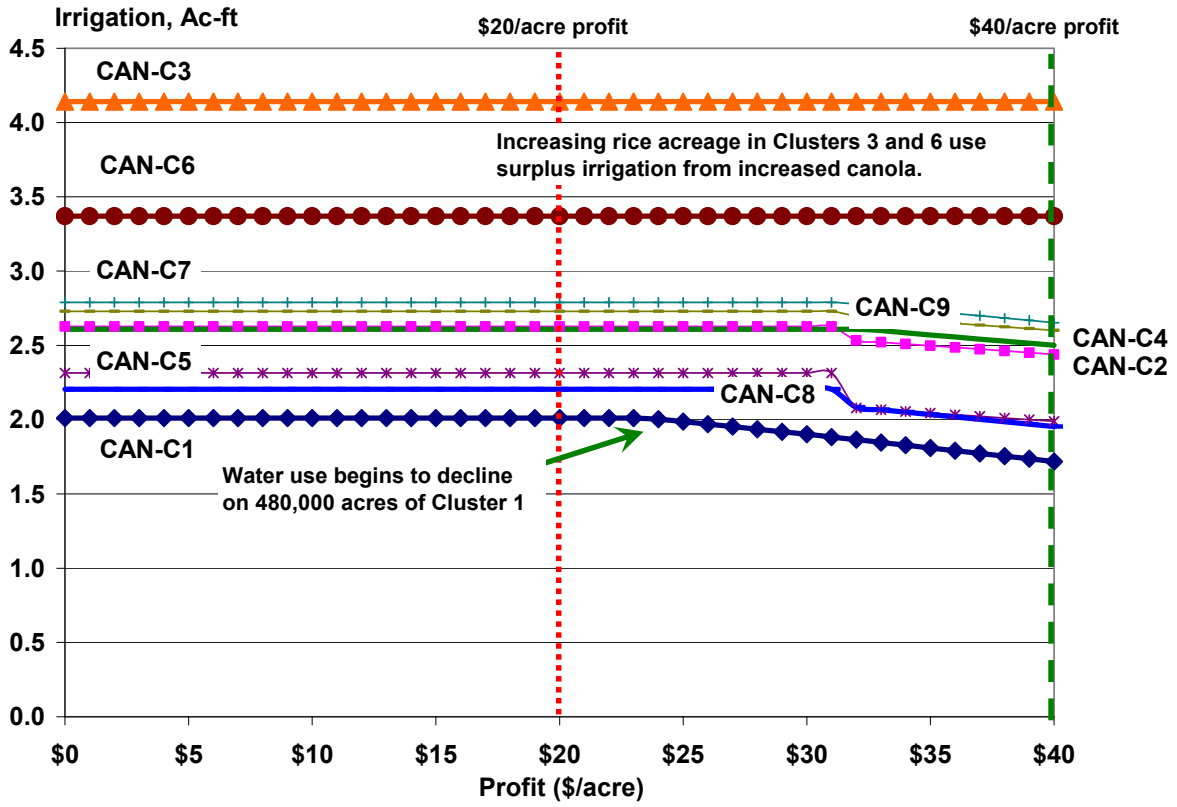
| Cluster | Increased Profit↑ | Entry Price | Canola Share | Total Acres | Cluster Share of Region | Change in $ /%Canola Acre |
|---|---|---|---|---|---|---|
| **C1** | $21 | $361 | 23.8% | 476,419 | 31.0% | 0.77 |
| **C2** | $23 | $363 | 4.1% | 82,923 | 5.4% | 0.77 |
| **C3** | $11 | $351 | 0.1% | 332,839 | 21.6% | 18.18 |
| **C4** | $23 | $363 | 11.2% | 261,446 | 17.0% | 1.61 |
| **C5** | $23 | $363 | 3.5% | 33,975 | 2.2% | 0.46 |
| **C6** | $7 | $347 | 0.2% | 68,550 | 4.5% | 2.90 |
| **C7** | $7 | $347 | 0.2% | 95,470 | 6.2% | 1.92 |
| **C8** | $23 | $363 | 4.9% | 109,203 | 7.1% | 0.53 |
| **C9** | $7 | $347 | 0.2% | 78,148 | 5.1% | 1.75 |

### 3.3.2 Water-Use and Canola Adoption

The average water-use in the NCA Region is 2.6 acre-feet of water for all the crops and all the acres. However when the water-use is looked at by individual cluster, the water-use ranges from 2.0 acre-feet of water to 4.1 acre-feet of water (Figure 25). Water-use does not change for any of the clusters at the $20/acre profit level.

Above that profit level most of the clusters begin to lower their water-use requirement as more acreage of canola is adopted. In the clusters with significant rice crops, Cluster 3 and 6, the rice acreage uses the water not because of the entry of canola into the rotation, to increase rice production. Cluster 7 also produces significant rice production, but the additional production of melons competes with rice for increased profit. As increased canola profit approaches $40/acre, water-use within Cluster 7 also declines.

**Figure 25: Impact of canola adoption on water use within each cluster.**




## 3.4 Cluster-specific sweet sorghum adoption in the SSJ Region

For contrast with the discussion on the NCA Region and canola adoption, the sweet sorghum adoption activities are compared in the South San Joaquin (SSJ) Region. While the NCA Region of California is large and diverse, the SSJ Region is large and specialized.

Figure 26 illustrates that most of the land (larger bubbles), falls into the irrigation water-use of 3.5 acre-feet and has either 6 or 10 crops per cluster. Almost 70 percent of the land in the SSJ Region falls into the three largest cropping clusters.

The homogeneity of the SSJ cropping clusters is even more apparent in comparison of the sweet sorghum adoption rates Figure 27. Sweet sorghum production in the SSJ Region enters the crop rotations at the same profit level, $6.25/ton; and at between 1.5 and 3.0 percent of the cropping cluster share in six of the eight cropping clusters. The addition of sweet sorghum into the rotation occurs at similar rates (slopes). The one anomaly is that Cluster 6 did not reach a level in which sweet sorghum entered the rotation at profits below $40/acre (zero acres of sweet sorghum were planted).

Energy crop adoption water-use within each cluster is determined by the crop composition, the amount of acres, and the profit per acre of these crops. Each cropping cluster within each

region has a different resource base. Therefore they are optimized independently, because they quite likely will produce different results.

**Figure 26: Attributes for the eight cropping clusters within the SSJ Region: crop number, average acre-feet, and cluster size (bubble size in acres).**

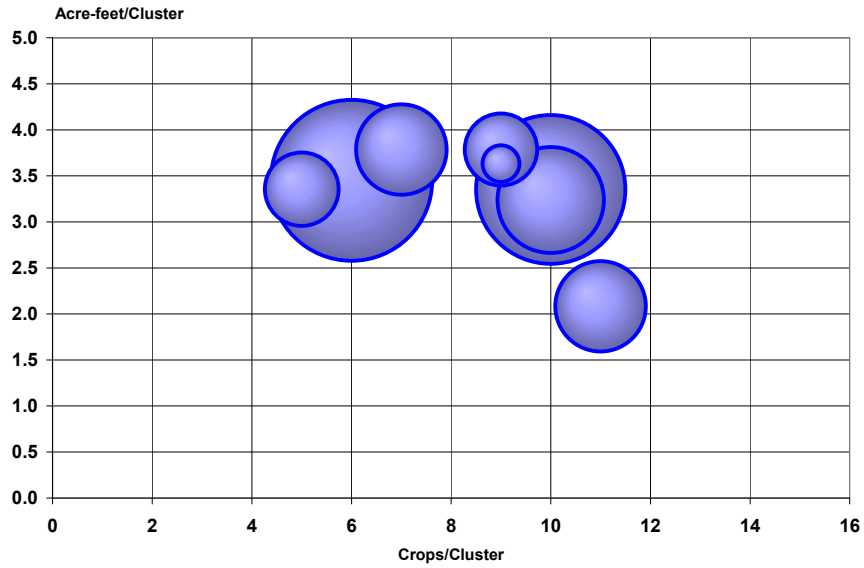
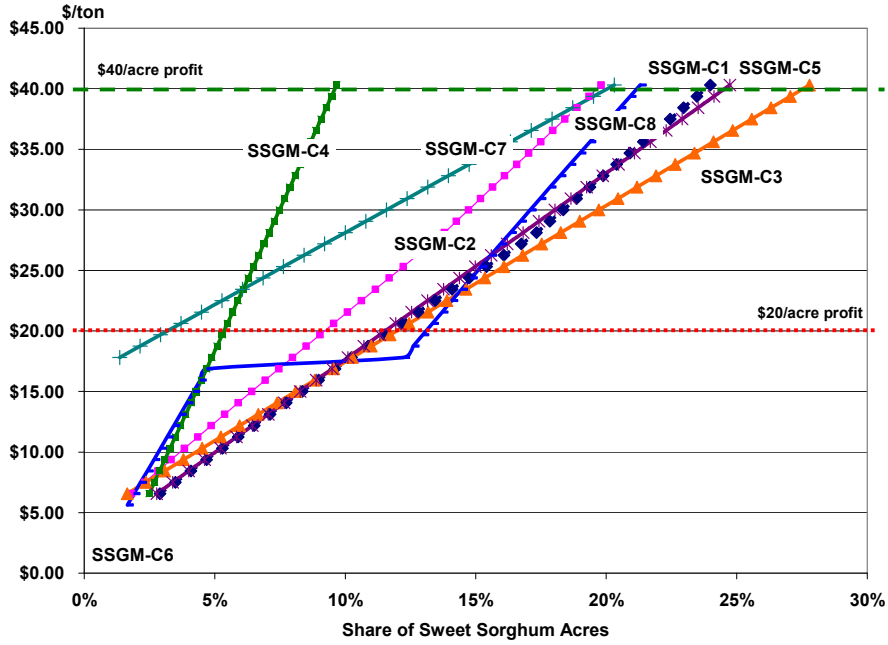



**Figure 27: Sweet sorghum adoption based on price of sweet sorghum and sweet sorghum acreage share of the cluster in Region SSJ**



## 3.5 State and Regional Impacts of Increased Profit and Bioenergy Crop Adoption

This California Bioenergy Crop Model does an excellent job of optimizing the local resource development opportunities. It also does a good job modeling state and regional levels by simply aggregating up from the cluster level. Figures have been developed for each of the five energy crops at both the $20/acre and $40/acre profit levels. These figures summarize the regional and state-level effects.

Because of the difficulty in establishing a long-term increased profit of $40/acre, the $40/acre profit level should be viewed as an extreme scenario. This relatively high increase in profit is compelling because the changes are large enough to understand the agronomic and economic implications. The $20/acre profit is a more moderate increase in profit from the production of a single crop. It is also important to remember that each of these five energy crop results is presented exclusively of the other energy crops. To understand the influence of each energy crop on cropping pattern clusters it was important to model the impact of each bioenergy crop separately. The state and regional-level aggregation are reasonable estimates, but as bioenergy crop production evolves in California bioenergy crop production will be a mix of many possible energy crops.

The local effects of the 45 cropping pattern clusters are evident in the results of this analysis. A point was made in Chapter 2 that the South San Joaquin Valley (SSJ) was much more homogeneous than the Northern California (NCA) region. However, on an economic basis the SSJ frequently was more sensitive to increases in energy crop acreage at the $40 profit-level than the NCA region.

For both the canola and sweet sorghum crops at the $40/acre profit level, the NCA region converted more existing cropping acres to the energy crop than did the SSJ region. At the $20/acre profit level though the SSJ region had higher increased energy crop production. Canola and sweet sorghum are both crops that are currently not commercially grown in California.

The other three energy crops: sugarbeets, safflower, and bermudagrass; are all currently grown for commercially at this time or were in the recent past. With increased profit from safflower and bermudagrass crops, the SSJ region had the greatest increase in energy-crop acres – usually for both the $20/acre profit-level and the $40/acre profit level. Only sugarbeets increased significantly in the Central San Joaquin Valley region, while other crops did not. The NCA region did not increase energy crop acreage very much for the other crops already grown in California.

Other specific results are compared below by each bioenergy crop.

### 3.5.1 Findings for Canola

The most compelling results of increased canola profits are not the similarities, but the differences.

- Water use when canola was adopted declined due to canola's low water requirement. As canola profit increased from $20/acre to $40/acre, the amount of decreased water-use increases, but not proportionally to the increased canola production(Figure 28). There is very little water-use conservation at the $20/acre profit level, but declines in water-use in every region at the $40/acre profit level.
- At the $20/acre profit level, the SSJ Region has the greatest increase in canola acreage, but at the $40/acre level, the NCA Region has the greatest increase in canola acreage.
- The CEN Region has the least acreage increase at the $20/acre level, but the SCA Region has the least acreage increase at the $40/acre level.

- With an exclusive increase in canola profit ($40/acre) canola will be adopted on 22 percent of the acreage, but at the $20/acre profit level this drops to just over an 8 percent increase in canola acreage (Figure 29).
- In the case of canola, sugarbeets and rice acreage also increased with canola.
- The lowest value crops typically left the rotation first. At the $20/acre increase in profit, oat hay had the largest decline in acreage as canola acreage increased. At the $40/acre profit level, cotton acreage declined the most. Cotton prices were low in the analysis, relative to other crops. A more recent shortage of the world cotton supply has caused current cotton price to increase. Increased cotton prices would likely produce a different allocation of resources.

**Figure 28: Region-level percent changes in canola production and water utilization at a long-term $20/acre and $40/acre profit increase in canola**

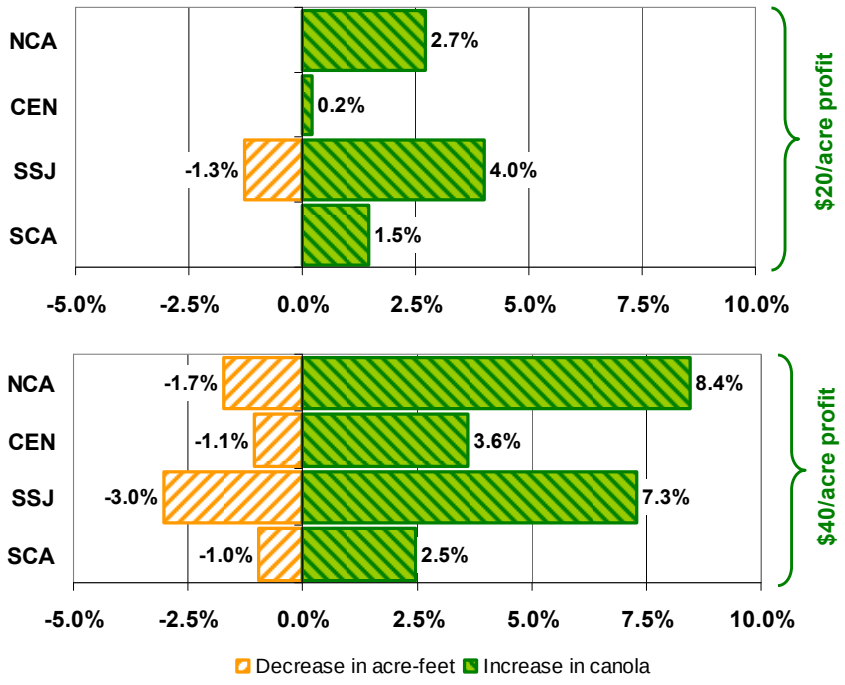
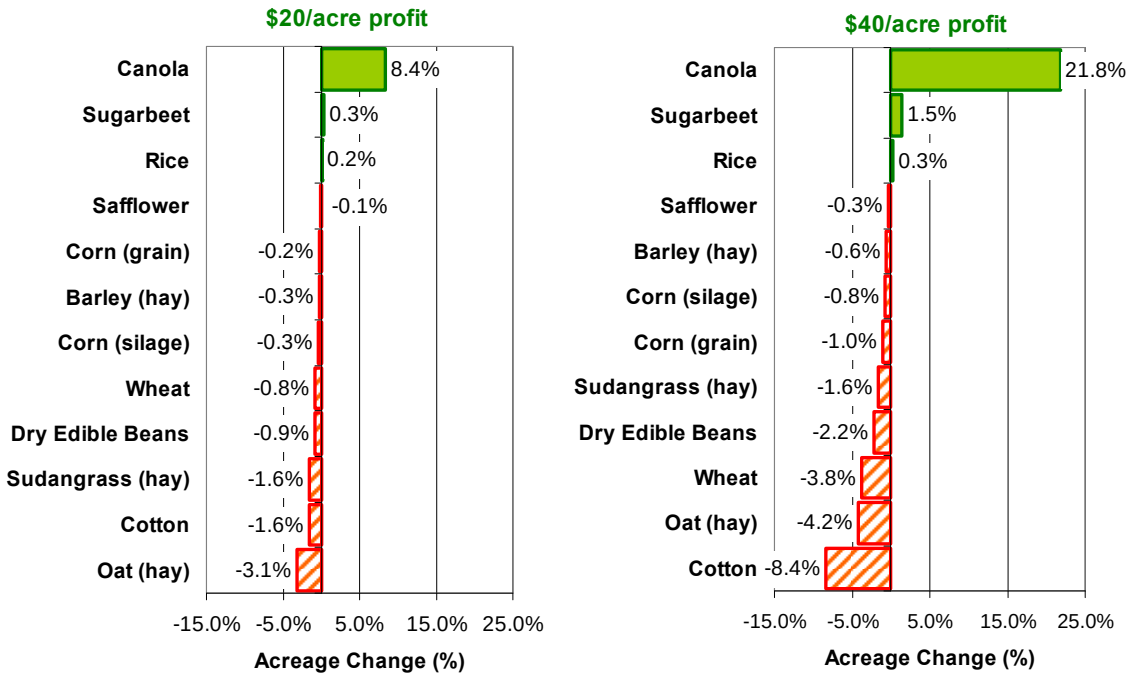


**Figure 29: State-level percent change in all crop production acres at a long-term $20/acre and $40/acre profit increase in canola**




### 3.5.2 Findings for Sweet Sorghum

Sweet sorghum uses a greater allocation of water than canola and other crops in the traditional rotation. As profits for sweet sorghum increase, the constraint on water-use within the cropping pattern cluster caused the model to fallow cropland. In the regional comparison of increased sweet sorghum acreage and profit, the left-hand factor represents the percent of fallowed land rather than a water-use reduction canola result.

- The NCA Region had the greatest adoption of sweet sorghum at the $40/acre profit, while there was no sweet sorghum acreage increase at the $20/acre profit level in the NCA Region (Figure 30).
- The SSJ Region had the second highest acreage increase at the $40/acre profit level and the highest level at the $20/acre profit.
- While the NCA Region had the greatest acreage increase at the $40/acre level, because the NCA Region has the greatest rainfall, no land was fallowed as sweet sorghum acreage increased.
- The CEN Region had the lowest sweet sorghum acreage increase at the $40/acre profit and no acreage increase at the $20/acre profit level.

- For an exclusive increase in sweet sorghum profit ($40/acre), sweet sorghum will be adopted on 15 percent of acres, while at the $20/acre profit level less than 3 percent of sweet sorghum acreage was adopted (Figure 31).

- The three crops with the largest acreage reduction were cotton, oat hay, and dry edible beans. This order was the same at both the $20/acre and $40/acre profit levels.

**Figure 30: Region-level percent changes in sweet sorghum production and acres fallowed at a long-term $40/acre profit increase in sweet sorghum**

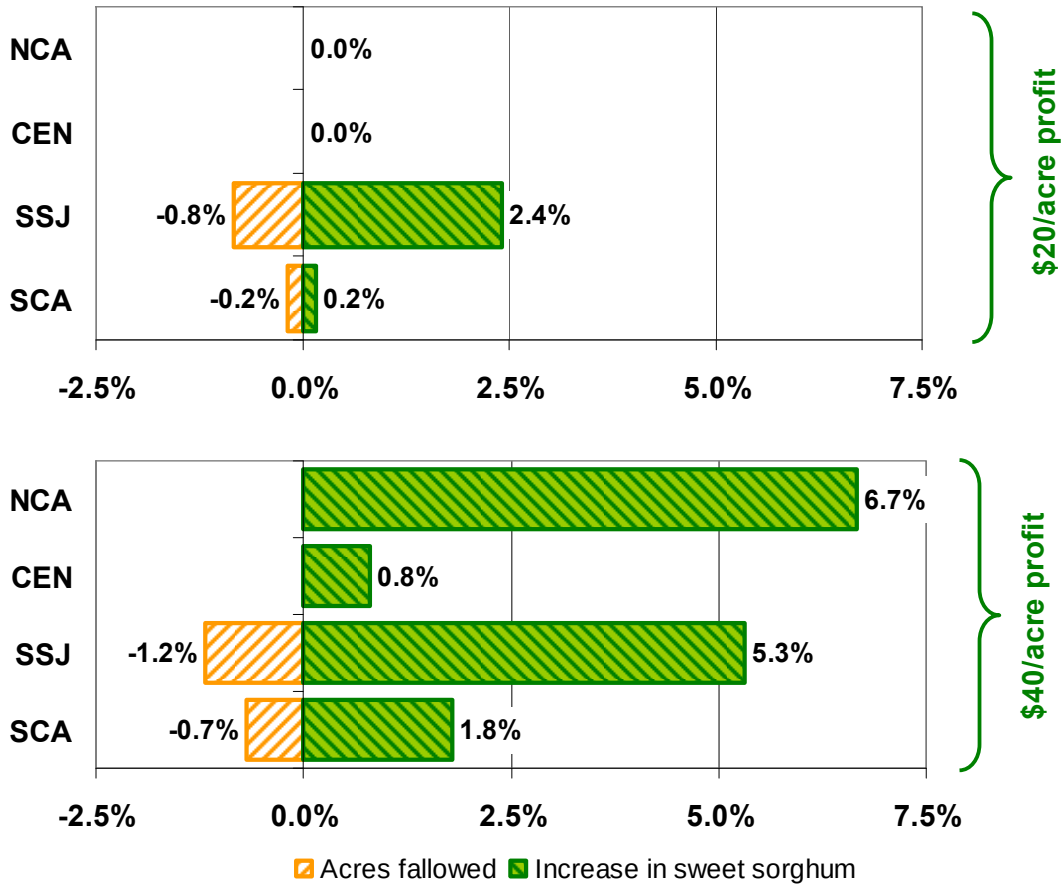
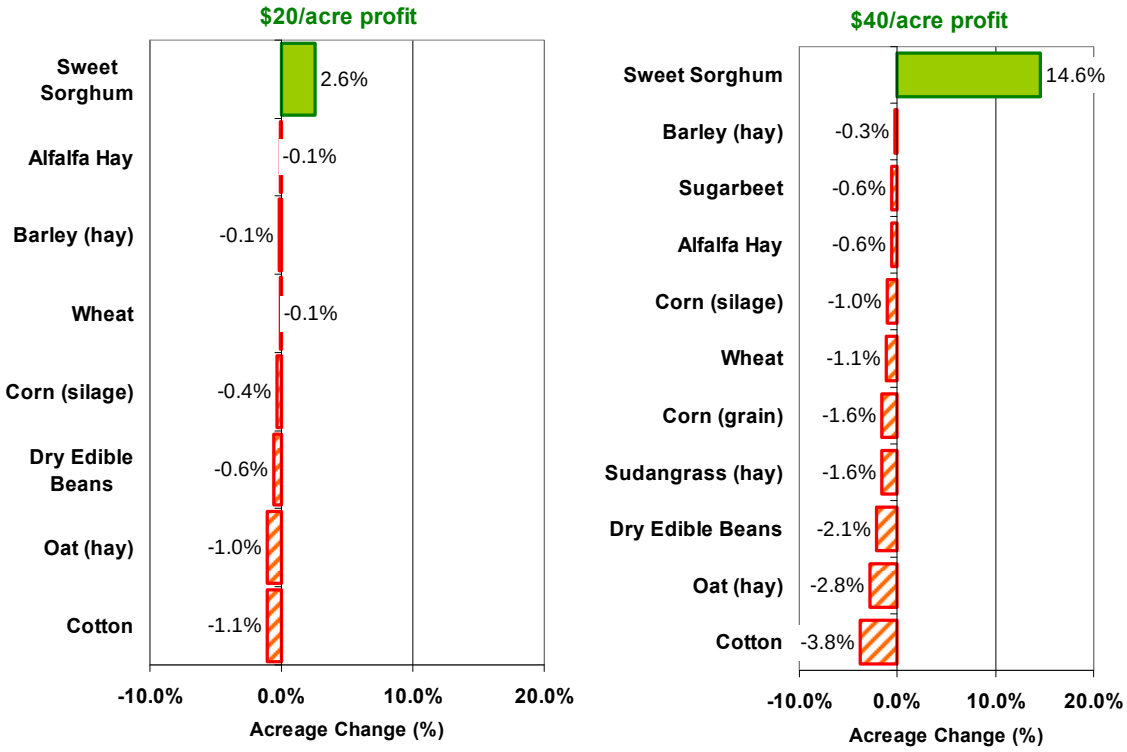


**Figure 31: State-level percent change in all crop production acres at a long-term $40/acre profit increase in sweet sorghum**




### 3.5.3 Findings for Sugarbeets

Sugarbeet adoption behaved unlike any of the other crops in some ways.

- The CEN Region increased sugarbeet acreage adoption the most of any region at both the $20/acre profit and at $40/acre profit (Figure 32).
- While the $20/acre profit level is 50 percent of a $40/acre profit, the sugarbeet acreage adoption in the CEN Region at the $20/acre profit is 88 percent of the sugarbeet acreage adopted at the $40/acre profit.
- Like with sweet sorghum, increased water-use requirements caused land to be fallowed when sugarbeet acreage adoption was great enough. However at the $40/acre profit level in the SSJ Region, 1.2 percent of the acreage was fallowed for both sugarbeets and sweet sorghum, only 0.9 percent of the cropland acreage was adopted by sugarbeets. Under the same conditions for sweet sorghum over 5 percent of cropland acreage was adopted by sweet sorghum.

- For an exclusive increase in profit ($40/acre), sugarbeets will be adopted on 9 percent of acres (Figure 33). At the $20/acre profit, 5 percent of state cropland acreage is adopted by sugarbeets.

- As with sweet sorghum the rank of the crops losing the most acreage to sugarbeets was the same order at the $20/acre profit and the $40/acre profit. Those crops in order of greatest acreage lost to least are: cotton, dry edible beans, and corn silage.
- Unlike canola and safflower, as the sugarbeet acreage increased rice acreage decreased.

**Figure 32: Region-level percent changes in sugarbeets production and acres fallowed at a long-term $40/acre profit increase in sugarbeets**

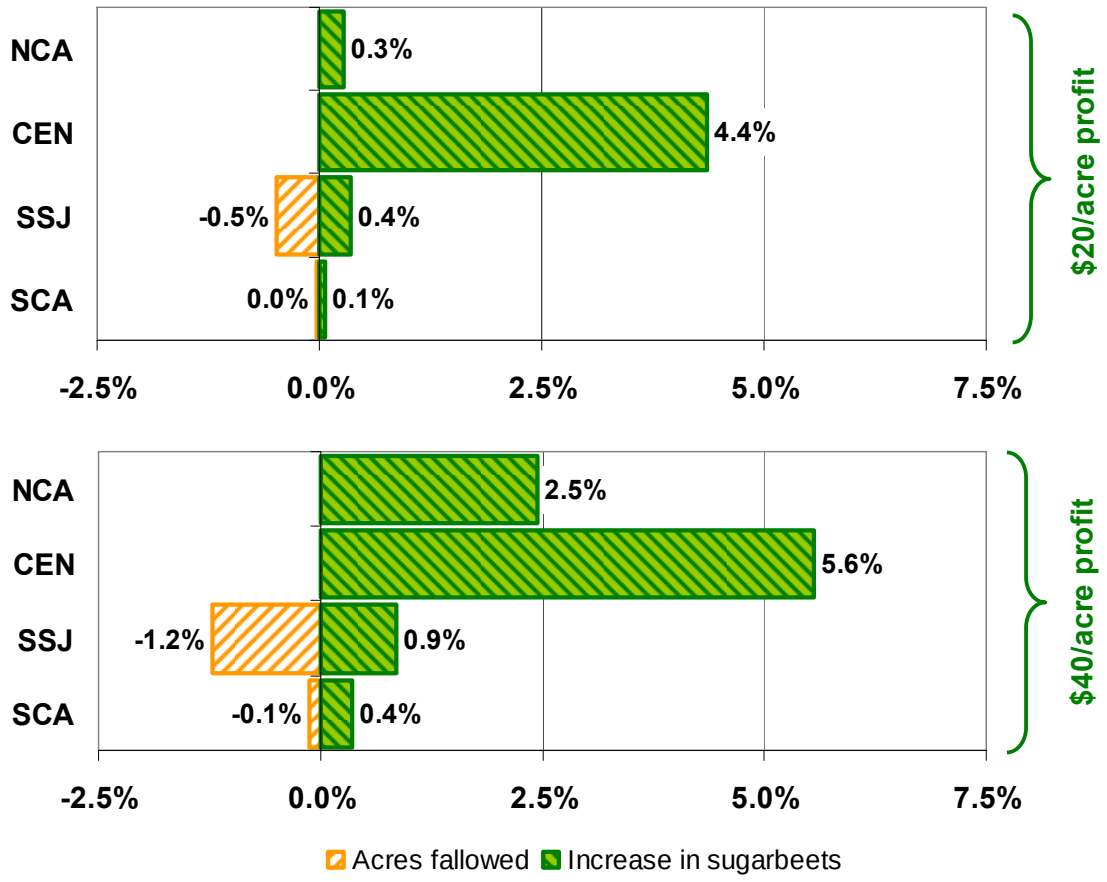
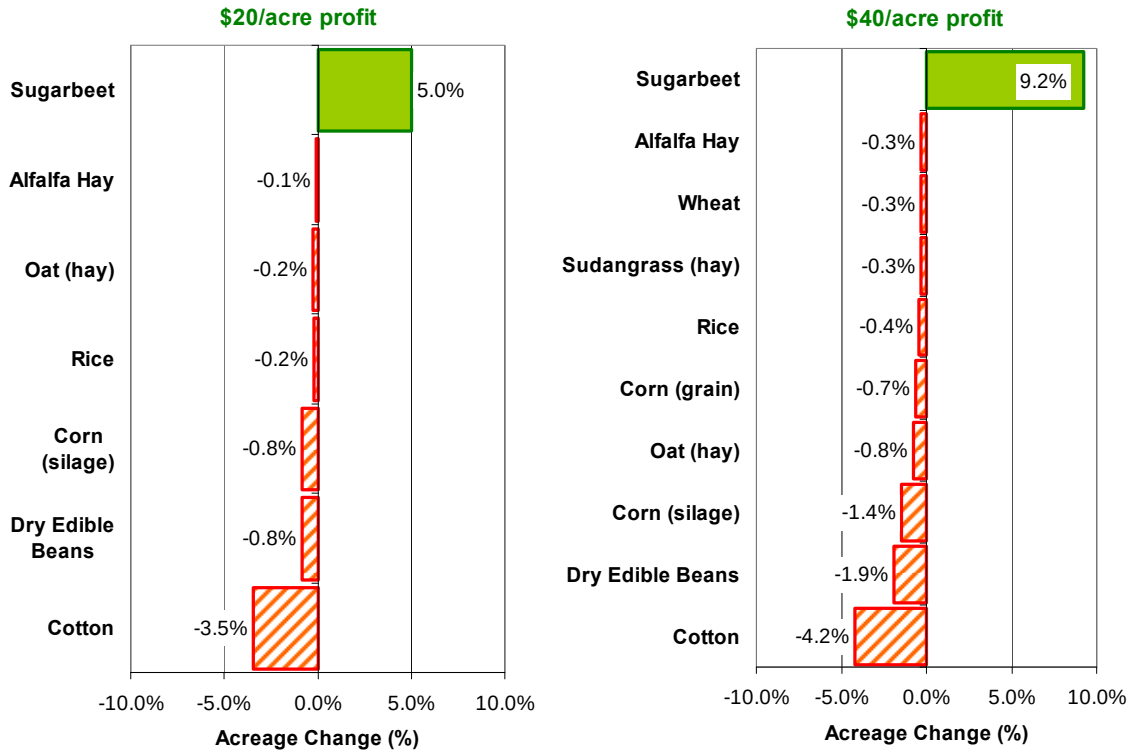


**Figure 33: State-level percent change in all crop production acres at a long-term $40/acre profit increase in sugarbeets**




## 3.54 Findings for Safflower

Safflower generally followed similar behavior as canola with some exceptions.

- The SSJ Region had the greatest energy-crop acreage adoption at both the $20/acre and $40/acre profit levels (Figure 34).
- At the $20/acre profit level, only the SSJ Region experienced some water-use reduction.
- At the $40/acre profit level, the NCA Region saw no water-use reduction while the other three regions experienced higher levels of water-use reduction than at the same profit levels from canola. Increased canola acreage at the $40/acre profit level saw moderate water-use reduction in all four regions with active acreage adoption.
- Safflower was the only energy crop to result in any acreage adoption in the COA Region. While one cluster adopted a few hundred acres of safflower, that amount was too small to show up in any of these charts. See Appendix A for actual values.

- With an exclusive increase in safflower profit ($40/acre), safflower will be adopted on 11 percent of the acreage (Figure 35). At the $20/acre profit level, 5 percent of energy crop acreage was adopted.
- In the case of safflower, sugarbeets and rice acreage also increased with safflower.
- Cotton acreage declined the most at both profit levels as safflower acreage increased. After cotton the rank order of declining crop acreage differed between the $20/acre and $40 acre profit levels.

**Figure 34: Region-level percent changes in safflower production and water utilization at a long-term $40/acre profit increase in safflower**

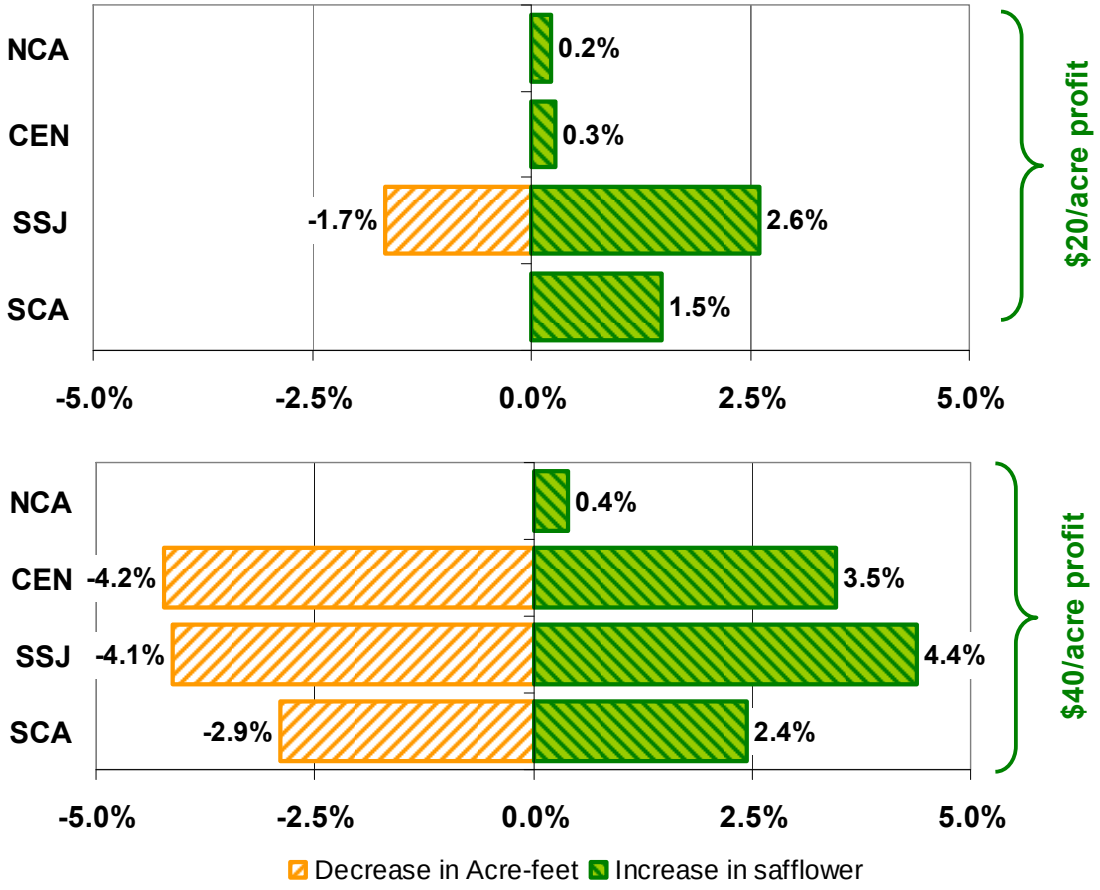
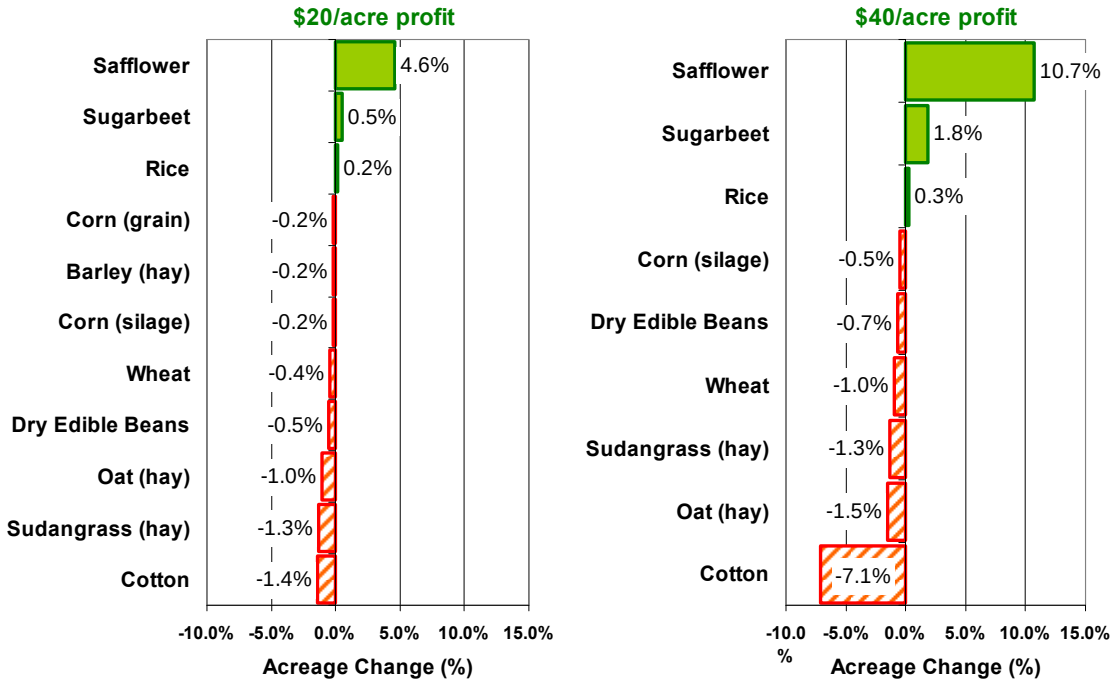


**Figure 35: State-level percent change in all crop production acres at a long-term $40/acre profit increase in safflower**




### 3.5.5 Findings for Bermudagrass

Bermudagrass saw the least amount of acreage adoption of any of the five energy crop analyzed. Bermudagrass is likely the least adaptable to multiple regions as any of the other crops. While it will grow in all the regions, the economics are most prohibitive outside of the SCA Region.

- The SSJ Region showed the greatest increase in bermuda grass adoption at both the $20/acre and $40/acre profit levels (Figure 36).
- There was no bermudagrass acreage adoption at either profit level in the CEN Region. The NCA and SCA region saw little to no bermudagrass adoption activity at the $20/acre profit levels.
- Some acreage was fallowed as bermudagrass acreage increased in both the SSJ and SCA Regions.
- For an exclusive increase in bermudagrass profit ($40/acre), bermudagrass will be adopted on 4 percent of acres (Figure 37). The level of bermudagrass acreage adoption was less than 1 percent at the $20/acre profit level.
- While little acreage adoption occurred with bermudagrass on a state-wide level, the rank order of crops with declining acreage differed between the $20/acre and $40/acre profit levels.

**Figure 36: Region-level percent changes in bermudagrass production and acres fallowed at a long-term $40/acre profit increase in bermudagrass**

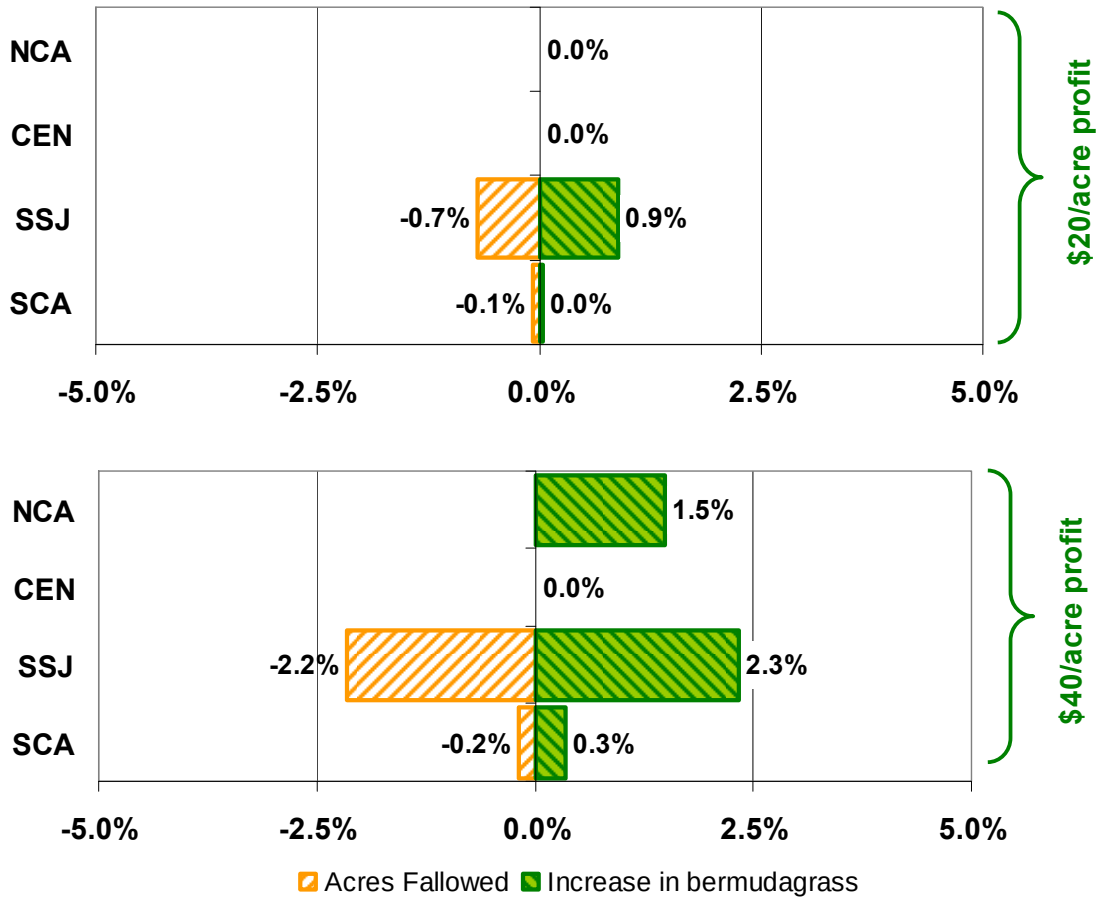
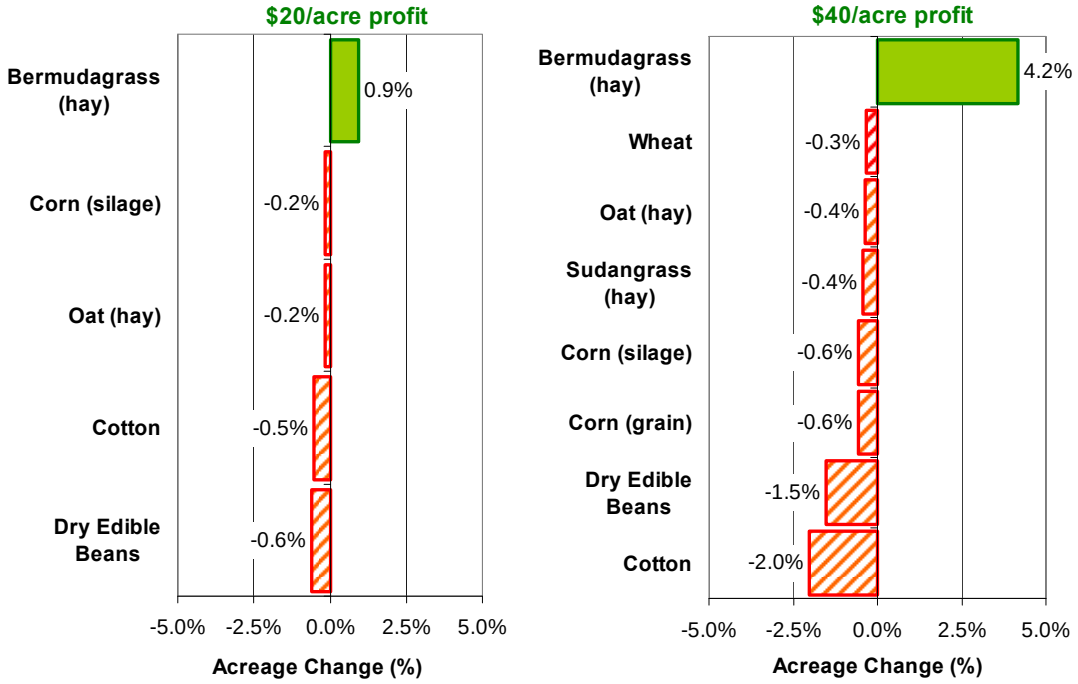

NCA
CEN
SSJ
SCA
0.0%
0.0%
-0.7%
0.9%
-0.1%
0.0%
$20/acre profit
-5.0%
-2.5%
0.0%
2.5%
5.0%
NCA
CEN
SSJ
SCA
1.5%
0.0%
-2.2%
2.3%
-0.2%
0.3%
$40/acre profit
-5.0%
-2.5%
0.0%
2.5%
5.0%
Acres Fallowed
Increase in bermudagrass

**Figure 37: State-level percent change in all crop production acres at a long-term $40/acre profit increase in bermudagrass**



# CHAPTER 4:
# Conclusions

The California Bioenergy Crop Adoption Model was effective at capturing the current economic decision criteria, local natural resource variation aggregated up to regional and state-level effects.

The most compelling shifts are apparent within the local (sub-regional) cropping pattern clusters. Each of the 45 independent cropping pattern clusters has a unique response to an economic profit incentive from energy crop production. While some of the clusters respond similarly to adoption of the same energy crop, many of them respond quite differently. These energy crop adoption factors include cropping pattern mix, as well as the profits for each crop in the cluster, acreage allocation within the cluster, and water-use of existing crops and the incoming energy crop.

Each cropping pattern cluster was modeled over an incremental increase in profit from a purpose-grown energy crop. The five energy crops included in this analysis are: canola, sweet sorghum, sugarbeets, safflower, and bermudagrass. Each energy crop was modeled separately, as if only one energy crop could be added to any given cropping pattern cluster. This increased profit represents the additional incentive required to move a farmer from existing cropping rotations to one that included an energy crop.

The common crops produced within a cropping pattern cluster were optimized for profit, and so the smallest unit of economic analysis was between the cropping activities within one of the 45 cropping patter clusters. These profit-derived impacts were then aggregated to a regional level and compared across the five established regions in the state. The third level of aggregation examined was the overall impact of the economic analysis for each cluster, summed to the state level.

Each energy crop of interest increased iteratively over a range of profit that spanned $0/acre to $40/acre in profit. At $0/acre profit the cluster operates at historical levels. At $40/acre profit, output price, yield and input costs all interact in a way that creates a relative increase of $40/acre net profit. For reference a representative $20/acre profit increase is also reported. These $20/acre and $40/acre profit metrics are merely reference points. The real profit will be determined by a bioenergy conversion facility entering an area and offering to pay more for the production of the energy crop than is currently realized with the historical crop rotation.

The oilseed crops, canola and safflower, required lower amounts of water for production than the other three crops: sweet sorghum, sugarbeets, and bermudagrass. As the profit level of these oilseed crops increased, the cumulative, average water-use requirements across a cluster often decreased. In a few cases as energy crop profit approached $40/acre, the acreage of rice or tomatoes also increased. These irrigation intensive crops utilized the newly available water from lower valued crops like cotton, oat hay, and dry edible beans leaving the rotation for the energy crop.

As the profit and cropping activity of the other energy crops increased other impacts were observed. Because the water-use levels were constrained by the existing use from historically grown crops and as the average water-use increased with increased profit levels, total planted acreage declined. These non-oilseed crops could become profitable enough to require some cropland to be fallowed in order to realize the higher profit from crops that required higher levels of water.

Very little of either water-related effect was common below the $20/acre profit levels. These effects both increased fallow land and decreased average water-use and were more common at the higher $40/acre profit levels.

These results are dependent on the conditions of the analysis which included:

- Historical crop displacement in existing cultivated cropland. The current analysis does not include perennial fruit/nut trees, vine crops, dryland rangeland, or irrigated pastures. As the model continues to develop, these will be added.
- A spatial component where the energy crops is introduced and the historical crops that are displaced in the rotation. For instance, energy crops that displace cotton will only reflect the model results if the energy crop is grown where the cotton was historically grown.
- All enterprise budgets adjusted to the price and yield levels of 2007. In addition regional prices differences are based on historical regional differences. As real prices shift, the results of the analysis will also shift.

Until more research is conducted on the agronomics of energy crops there will be some uncertainty that the model acreage displaced by an energy crop can actually support the production of an energy crop. The current analysis is based on economics, water-use and acreage. Some field conditions and crop adaptation constraints may interfere with energy crop production. This will continue to be monitored and the subject of crop production research.

**THIS ANALYSIS ILLUSTRATED THAT WHEN LOCAL RESOURCES ARE OPTIMIZED BASED ON LOCAL LAND AND WATER-USE CONSTRAINTS, COMPELLING INFORMATION ON REQUISITE PROFIT LEVELS CAN BE ESTABLISHED.**

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# APPENDIX A:
# Data Output Tables

### Table E.1 Acreage changes in NCA Region from a $20/acre increase in profit from canola

**Change in acres from $20/acre increase in canola profit**

| 1,538,984 | Acres | 476,419 | 82,923 | 332,849 | 261,446 | 33,975 | 68,550 | 95,470 | 109,203 | 78,148 |
|---|---|---|---|---|---|---|---|---|---|---|
| | **NCA-ALL** | **NCA-C1** | **NCA-C2** | **NCA-C3** | **NCA-C4** | **NCA-C5** | **NCA-C6** | **NCA-C7** | **NCA-C8** | **NCA-C9** |
| Alfalfa | 80 | (125) | 0 | 0 | 0 | 0 | (5) | 17 | 0 | 194 |
| Barley | (873) | (873) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beans | (11,140) | (2,080) | 0 | 0 | 0 | 0 | (1,361) | (5,771) | 0 | (1,928) |
| Corn - Grain | (11,302) | (2,426) | 0 | (9,542) | 0 | 0 | (193) | 341 | 0 | 518 |
| Melons | (196) | (31) | 0 | 0 | 0 | 0 | 0 | (140) | 0 | (24) |
| Oats | (91,328) | (88,338) | 0 | 0 | 0 | 0 | (1,725) | 0 | 0 | (1,265) |
| Onions | (3) | (4) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Potatoes | (28) | (28) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rice | 10,219 | (166) | 0 | 6,809 | 0 | 0 | 702 | 2,873 | 0 | 0 |
| Wild Rice | (371) | (371) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Safflower | (1,785) | (90) | 0 | 0 | 0 | 0 | (146) | (1,128) | 0 | (420) |
| Sorghum | 301 | 0 | 0 | 0 | 0 | 0 | 0 | 301 | 0 | 0 |
| Sugarbeets | 253 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 253 |
| Sudangrass | (16,876) | (16,876) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tomatoes | 228 | (81) | 0 | 0 | 0 | 0 | (5) | 0 | 0 | 314 |
| Wheat | (9,752) | (1,758) | 0 | (1,459) | 0 | 0 | (1,157) | (2,703) | 0 | (2,675) |
| Canola | 132,585 | 113,248 | 0 | 4,202 | 0 | 0 | 3,892 | 6,210 | 0 | 5,032 |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $20/acre increase in canola profit**

| 1,538,984 | Acres | 476,419 | 82,923 | 332,849 | 261,446 | 33,975 | 68,550 | 95,470 | 109,203 | 78,148 |
|---|---|---|---|---|---|---|---|---|---|---|
| 4,266,283 | Ac-ft Water | 958,140 | 217,857 | 1,378,289 | 681,790 | 78,639 | 231,009 | 266,351 | 240,880 | 213,329 |
| 2.77 | Ac-ft/Acre | | | | | | | | | |
| | **NCA-ALL** | **NCA-C1** | **NCA-C2** | **NCA-C3** | **NCA-C4** | **NCA-C5** | **NCA-C6** | **NCA-C7** | **NCA-C8** | **NCA-C9** |
| Alfalfa | 0.005% | -0.008% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.001% | 0.000% | 0.013% |
| Barley | -0.057% | -0.057% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -0.724% | -0.135% | 0.000% | 0.000% | 0.000% | 0.000% | -0.088% | -0.375% | 0.000% | -0.125% |
| Corn - Grain | -0.734% | -0.158% | 0.000% | -0.620% | 0.000% | 0.000% | -0.013% | 0.022% | 0.000% | 0.034% |
| Melons | -0.013% | -0.002% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.009% | 0.000% | -0.002% |
| Oats | -5.934% | -5.740% | 0.000% | 0.000% | 0.000% | 0.000% | -0.112% | 0.000% | 0.000% | -0.082% |
| Onions | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Potatoes | -0.002% | -0.002% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Rice | 0.664% | -0.011% | 0.000% | 0.442% | 0.000% | 0.000% | 0.046% | 0.187% | 0.000% | 0.000% |
| Wild Rice | -0.024% | -0.024% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Safflower | -0.116% | -0.006% | 0.000% | 0.000% | 0.000% | 0.000% | -0.010% | -0.073% | 0.000% | -0.027% |
| Sorghum | 0.020% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.020% | 0.000% | 0.000% |
| Sugarbeets | 0.016% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.016% |
| Sudangrass | -1.097% | -1.097% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | 0.015% | -0.005% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.020% |
| Wheat | -0.634% | -0.114% | 0.000% | -0.095% | 0.000% | 0.000% | -0.075% | -0.176% | 0.000% | -0.174% |
| Canola | 8.615% | 7.359% | 0.000% | 0.273% | 0.000% | 0.000% | 0.253% | 0.404% | 0.000% | 0.327% |
| Acre-feet of Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $20/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.

## Table E.2 Acreage change in NCA Region from a $40/acre increase in profit from canola

**Change in acres from $40/acre increase in canola profit**

| Cluster share of region | | 31.0% | 5.4% | 21.6% | 17.0% | 2.2% | 4.5% | 6.2% | 7.1% | 5.1% |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,538,984 | Acres | 476,419 | 82,923 | 332,849 | 261,446 | 33,975 | 68,550 | 95,470 | 109,203 | 78,148 |
| | **NCA-ALL** | **NCA-C1** | **NCA-C2** | **NCA-C3** | **NCA-C4** | **NCA-C5** | **NCA-C6** | **NCA-C7** | **NCA-C8** | **NCA-C9** |
| Alfalfa | (3,068) | (1,519) | (109) | 0 | (1,414) | 0 | (77) | 5 | (13) | 59 |
| Barley | (16,757) | (13,262) | 0 | 0 | 0 | (349) | 0 | 0 | (3,146) | 0 |
| Beans | (71,375) | (28,312) | (5,188) | 0 | (7,745) | (4,372) | (1,361) | (10,513) | (9,398) | (4,487) |
| Corn - Grain | (50,576) | (29,479) | (1,291) | (9,542) | (5,179) | (531) | (660) | (330) | (3,062) | (502) |
| Melons | (1,338) | (573) | (69) | 0 | 0 | (57) | 0 | (412) | (155) | (72) |
| Oats | (124,461) | (88,338) | (2,350) | 0 | (23,076) | (698) | (3,953) | 0 | (3,320) | (2,727) |
| Onions | (76) | (53) | (6) | 0 | 0 | (4) | 0 | 0 | (9) | (3) |
| Potatoes | (439) | (386) | 0 | 0 | 0 | 0 | 0 | 0 | (53) | 0 |
| Rice | 8,471 | (1,628) | 0 | 6,809 | 0 | (6) | 817 | 2,511 | (31) | 0 |
| Wild Rice | (3,702) | (3,702) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Safflower | (9,555) | (2,318) | (779) | 0 | (1,003) | (382) | (350) | (2,696) | (1,024) | (1,004) |
| Sorghum | (1,254) | 0 | 0 | 0 | (961) | 0 | 0 | 26 | (319) | 0 |
| Sugarbeets | (4,611) | 0 | (630) | 0 | (2,439) | (173) | 0 | 0 | (759) | (610) |
| Sudangrass | (16,876) | (16,876) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tomatoes | (2,038) | (917) | (367) | 0 | (238) | (187) | (28) | 0 | (328) | 27 |
| Wheat | (114,032) | (45,196) | (9,790) | (4,325) | (16,524) | (5,138) | (2,765) | (6,460) | (17,442) | (6,392) |
| Canola | 411,699 | 232,559 | 20,578 | 7,068 | 58,577 | 11,897 | 8,379 | 17,870 | 39,059 | 15,711 |
| Acre-feet of Water | (263,073) | (148,446) | (16,623) | 0 | (31,644) | (11,454) | 0 | (14,565) | (29,298) | (11,044) |

**Percent regional change in cluster acreage from $40/acre increase in canola profit**

| 1,538,984 | Acres | 476,419 | 82,923 | 332,849 | 261,446 | 33,975 | 68,550 | 95,470 | 109,203 | 78,148 |
|---|---|---|---|---|---|---|---|---|---|---|
| 4,003,210 | Ac-ft Water | 809,694 | 201,234 | 1,378,289 | 650,146 | 67,185 | 231,009 | 251,786 | 211,582 | 202,285 |
| 2.60 | Ac-ft/Acre | | | | | | | | | |
| | **NCA-ALL** | **NCA-C1** | **NCA-C2** | **NCA-C3** | **NCA-C4** | **NCA-C5** | **NCA-C6** | **NCA-C7** | **NCA-C8** | **NCA-C9** |
| Alfalfa | -0.199% | -0.099% | -0.007% | 0.000% | -0.092% | 0.000% | -0.005% | 0.000% | -0.001% | 0.004% |
| Barley | -1.089% | -0.862% | 0.000% | 0.000% | 0.000% | -0.023% | 0.000% | 0.000% | -0.204% | 0.000% |
| Beans | -4.638% | -1.840% | -0.337% | 0.000% | -0.503% | -0.284% | -0.088% | -0.683% | -0.611% | -0.292% |
| Corn - Grain | -3.286% | -1.915% | -0.084% | -0.620% | -0.336% | -0.034% | -0.043% | -0.021% | -0.199% | -0.033% |
| Melons | -0.087% | -0.037% | -0.004% | 0.000% | 0.000% | -0.004% | 0.000% | -0.027% | -0.010% | -0.005% |
| Oats | -8.087% | -5.740% | -0.153% | 0.000% | -1.499% | -0.045% | -0.257% | 0.000% | -0.216% | -0.177% |
| Onions | -0.005% | -0.003% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.001% | 0.000% |
| Potatoes | -0.029% | -0.025% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.003% | 0.000% |
| Rice | 0.550% | -0.106% | 0.000% | 0.442% | 0.000% | 0.000% | 0.053% | 0.163% | -0.002% | 0.000% |
| Wild Rice | -0.241% | -0.241% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Safflower | -0.621% | -0.151% | -0.051% | 0.000% | -0.065% | -0.025% | -0.023% | -0.175% | -0.067% | -0.065% |
| Sorghum | -0.081% | 0.000% | 0.000% | 0.000% | -0.062% | 0.000% | 0.000% | 0.002% | -0.021% | 0.000% |
| Sugarbeets | -0.300% | 0.000% | -0.041% | 0.000% | -0.158% | -0.011% | 0.000% | 0.000% | -0.049% | -0.040% |
| Sudangrass | -1.097% | -1.097% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | -0.132% | -0.060% | -0.024% | 0.000% | -0.015% | -0.012% | -0.002% | 0.000% | -0.021% | 0.002% |
| Wheat | -7.410% | -2.937% | -0.636% | -0.281% | -1.074% | -0.334% | -0.180% | -0.420% | -1.133% | -0.415% |
| Canola | 26.751% | 15.111% | 1.337% | 0.459% | 3.806% | 0.773% | 0.544% | 1.161% | 2.538% | 1.021% |
| Acre-feet of Water | -6.572% | -3.708% | -0.415% | 0.000% | -0.790% | -0.286% | 0.000% | -0.364% | -0.732% | -0.276% |

Acres and Ac-feet values presented here represent the values used in the $40/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.

## Table E.3 Acreage change in NCA Region from a $20/acre increase in profit from sweet sorghum

**Change in acres from $20/acre increase in sweet sorghum profit**

| 1,538,971 | Acres | 476,419 | 82,923 | 332,839 | 261,446 | 33,975 | 68,548 | 95,470 | 109,203 | 78,148 |
|---|---|---|---|---|---|---|---|---|---|---|
| | **NCA-ALL** | **NCA-C1** | **NCA-C2** | **NCA-C3** | **NCA-C4** | **NCA-C5** | **NCA-C6** | **NCA-C7** | **NCA-C8** | **NCA-C9** |
| Alfalfa | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Barley | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beans | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Corn - Grain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Melons | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oats | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Onions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potatoes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rice | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wild Rice | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Safflower | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sorghum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sugarbeets | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sudangrass | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tomatoes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wheat | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sweet Sorghum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $20/acre increase in sweet sorghum profit**

| 1,538,971 | Acres | 476,419 | 82,923 | 332,839 | 261,446 | 33,975 | 68,548 | 95,470 | 109,203 | 78,148 |
|---|---|---|---|---|---|---|---|---|---|---|
| 4,254,829 | Ac-ft Water | 958,140 | 217,857 | 1,378,289 | 681,790 | 67,185 | 231,009 | 266,351 | 240,880 | 213,329 |
| 2.76 | Ac-ft/Acre | | | | | | | | | |
| | **NCA-ALL** | **NCA-C1** | **NCA-C2** | **NCA-C3** | **NCA-C4** | **NCA-C5** | **NCA-C6** | **NCA-C7** | **NCA-C8** | **NCA-C9** |
| Alfalfa | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Barley | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Corn - Grain | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Melons | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Oats | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Onions | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Potatoes | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Rice | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Wild Rice | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Safflower | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sorghum | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sugarbeets | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sudangrass | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Wheat | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sweet Sorghum | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Acre-feet of Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $20/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.

## Table E.4 Acreage change in NCA Region from a $40/acre increase in profit from sweet sorghum

**Change in acres from $40/acre increase in sweet sorghum profit**

| Cluster share of region | | 31.0% | 5.4% | 21.6% | 17.0% | 2.2% | 4.5% | 6.2% | 7.1% | 5.1% |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,538,971 | Acres | 476,419 | 82,923 | 332,839 | 261,446 | 33,975 | 68,548 | 95,470 | 109,203 | 78,148 |
| | **NCA-ALL** | **NCA-C1** | **NCA-C2** | **NCA-C3** | **NCA-C4** | **NCA-C5** | **NCA-C6** | **NCA-C7** | **NCA-C8** | **NCA-C9** |
| Alfalfa | (7,583) | (2,493) | (386) | 0 | (3,948) | 0 | (265) | (18) | (48) | (426) |
| Barley | (1,657) | 0 | 0 | 0 | 0 | (241) | 0 | 0 | (1,415) | 0 |
| Beans | (72,929) | (29,866) | (5,188) | 0 | (7,745) | (4,372) | (1,361) | (10,513) | (9,398) | (4,487) |
| Corn - Grain | (77,923) | (48,080) | (2,969) | 0 | (14,217) | (1,142) | (1,080) | (957) | (7,225) | (2,253) |
| Melons | (1,034) | (419) | (49) | 0 | 0 | (43) | 0 | (359) | (109) | (55) |
| Oats | (72,943) | (47,558) | (2,350) | 0 | (15,098) | (698) | (2,476) | 0 | (3,320) | (1,443) |
| Onions | (123) | (79) | (12) | 0 | 0 | (7) | 0 | 0 | (17) | (8) |
| Potatoes | (603) | (519) | 0 | 0 | 0 | 0 | 0 | 0 | (84) | 0 |
| Rice | (7,153) | (3,678) | 0 | 0 | 0 | (53) | (2,330) | (794) | (298) | 0 |
| Wild Rice | (7,345) | (7,345) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Safflower | (4,336) | (549) | (286) | 0 | (159) | (167) | (225) | (2,038) | (348) | (565) |
| Sorghum | (2,299) | 0 | 0 | 0 | (1,446) | 0 | 0 | (409) | (444) | 0 |
| Sugarbeets | (10,407) | 0 | (1,253) | 0 | (5,677) | (325) | 0 | 0 | (1,543) | (1,609) |
| Sudangrass | (16,876) | (16,876) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tomatoes | (6,173) | (1,665) | (1,137) | 0 | (908) | (537) | (72) | 0 | (1,050) | (803) |
| Wheat | (35,336) | (10,695) | (3,598) | 0 | (2,623) | (2,242) | (1,779) | (4,883) | (5,921) | (3,596) |
| Sweet Sorghum | 324,720 | 169,821 | 17,228 | 0 | 51,820 | 9,825 | 9,591 | 19,970 | 31,219 | 15,245 |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $40/acre increase in sweet sorghum profit**

| 1,538,971 | Acres | 476,419 | 82,923 | 332,839 | 261,446 | 33,975 | 68,548 | 95,470 | 109,203 | 78,148 |
|---|---|---|---|---|---|---|---|---|---|---|
| 4,254,829 | Ac-ft Water | 958,140 | 217,857 | 1,378,289 | 681,790 | 67,185 | 231,009 | 266,351 | 240,880 | 213,329 |
| 2.76 | Ac-ft/Acre | | | | | | | | | |
| | **NCA-ALL** | **NCA-C1** | **NCA-C2** | **NCA-C3** | **NCA-C4** | **NCA-C5** | **NCA-C6** | **NCA-C7** | **NCA-C8** | **NCA-C9** |
| Alfalfa | -0.493% | -0.162% | -0.025% | 0.000% | -0.257% | 0.000% | -0.017% | -0.001% | -0.003% | -0.028% |
| Barley | -0.108% | 0.000% | 0.000% | 0.000% | 0.000% | -0.016% | 0.000% | 0.000% | -0.092% | 0.000% |
| Beans | -4.739% | -1.941% | -0.337% | 0.000% | -0.503% | -0.284% | -0.088% | -0.683% | -0.611% | -0.292% |
| Corn - Grain | -5.063% | -3.124% | -0.193% | 0.000% | -0.924% | -0.074% | -0.070% | -0.062% | -0.469% | -0.146% |
| Melons | -0.067% | -0.027% | -0.003% | 0.000% | 0.000% | -0.003% | 0.000% | -0.023% | -0.007% | -0.004% |
| Oats | -4.740% | -3.090% | -0.153% | 0.000% | -0.981% | -0.045% | -0.161% | 0.000% | -0.216% | -0.094% |
| Onions | -0.008% | -0.005% | -0.001% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.001% | -0.001% |
| Potatoes | -0.039% | -0.034% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.005% | 0.000% |
| Rice | -0.465% | -0.239% | 0.000% | 0.000% | 0.000% | -0.003% | -0.151% | -0.052% | -0.019% | 0.000% |
| Wild Rice | -0.477% | -0.477% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Safflower | -0.282% | -0.036% | -0.019% | 0.000% | -0.010% | -0.011% | -0.015% | -0.132% | -0.023% | -0.037% |
| Sorghum | -0.149% | 0.000% | 0.000% | 0.000% | -0.094% | 0.000% | 0.000% | -0.027% | -0.029% | 0.000% |
| Sugarbeets | -0.676% | 0.000% | -0.081% | 0.000% | -0.369% | -0.021% | 0.000% | 0.000% | -0.100% | -0.105% |
| Sudangrass | -1.097% | -1.097% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | -0.401% | -0.108% | -0.074% | 0.000% | -0.059% | -0.035% | -0.005% | 0.000% | -0.068% | -0.052% |
| Wheat | -2.296% | -0.695% | -0.234% | 0.000% | -0.170% | -0.146% | -0.116% | -0.317% | -0.385% | -0.234% |
| Sweet Sorghum | 21.100% | 11.035% | 1.119% | 0.000% | 3.367% | 0.638% | 0.623% | 1.298% | 2.029% | 0.991% |
| Acre-feet of Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $40/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.

## Table E.5 Acreage change in NCA Region from a $20/acre increase in profit from sugarbeets

**Change in acres from $20/acre increase in sugarbeet profit**

| 1,538,727 | Acres | 476,419 | 82,923 | 332,839 | 261,446 | 33,975 | 68,548 | 95,470 | 109,203 | 77,903 |
|---|---|---|---|---|---|---|---|---|---|---|
| | **NCA-ALL** | **NCA-C1** | **NCA-C2** | **NCA-C3** | **NCA-C4** | **NCA-C5** | **NCA-C6** | **NCA-C7** | **NCA-C8** | **NCA-C9** |
| Alfalfa | (2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (2) |
| Barley | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beans | (14,628) | 0 | (1,889) | 0 | (7,307) | (519) | 0 | 0 | (2,274) | (2,638) |
| Corn - Grain | (6) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (6) |
| Melons | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oats | 1,348 | 0 | 210 | 0 | 812 | 58 | 0 | 0 | 253 | 15 |
| Onions | (0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (0) |
| Potatoes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rice | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wild Rice | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Safflower | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| Sorghum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sugarbeets - internal | 13,010 | 0 | 1,679 | 0 | 6,496 | 461 | 0 | 0 | 2,021 | 2,353 |
| Sudangrass | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tomatoes | (4) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (4) |
| Wheat | 32 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 32 |
| Sugarbeets - external | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $20/acre increase in sugarbeet profit**

| 1,538,727 | Acres | 476,419 | 82,923 | 332,839 | 261,446 | 33,975 | 68,548 | 95,470 | 109,203 | 77,903 |
|---|---|---|---|---|---|---|---|---|---|---|
| 4,254,829 | Ac-ft Water | 958,140 | 217,857 | 1,378,289 | 681,790 | 67,185 | 231,009 | 266,351 | 240,880 | 213,329 |
| 2.77 | Ac-ft/Acre | | | | | | | | | |
| | **NCA-ALL** | **NCA-C1** | **NCA-C2** | **NCA-C3** | **NCA-C4** | **NCA-C5** | **NCA-C6** | **NCA-C7** | **NCA-C8** | **NCA-C9** |
| Alfalfa | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Barley | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -0.951% | 0.000% | -0.123% | 0.000% | -0.475% | -0.034% | 0.000% | 0.000% | -0.148% | -0.171% |
| Corn - Grain | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Melons | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Oats | 0.088% | 0.000% | 0.014% | 0.000% | 0.053% | 0.004% | 0.000% | 0.000% | 0.016% | 0.001% |
| Onions | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Potatoes | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Rice | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Wild Rice | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Safflower | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sorghum | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sugarbeets - internal | 0.845% | 0.000% | 0.109% | 0.000% | 0.422% | 0.030% | 0.000% | 0.000% | 0.131% | 0.153% |
| Sudangrass | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Wheat | 0.002% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.002% |
| Sugarbeets - external | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Acre-feet of Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $20/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added.

## Table E.6 Acreage change in NCA Region from a $40/acre increase in profit from sugarbeets

**Change in acres from $40/acre increase in sugarbeet profit**

| Cluster share of region | | 31.0% | 5.4% | 21.6% | 17.0% | 2.2% | 4.5% | 6.2% | 7.1% | 5.1% |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,538,727 | Acres | 476,419 | 82,923 | 332,839 | 261,446 | 33,975 | 68,548 | 95,470 | 109,203 | 77,903 |
| | **NCA-ALL** | **NCA-C1** | **NCA-C2** | **NCA-C3** | **NCA-C4** | **NCA-C5** | **NCA-C6** | **NCA-C7** | **NCA-C8** | **NCA-C9** |
| Alfalfa | (2,281) | (1,526) | 0 | 0 | (623) | 0 | (109) | (13) | 0 | (10) |
| Barley | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beans | (58,014) | (23,355) | (3,583) | 0 | (8,981) | (984) | (1,361) | (10,513) | (4,312) | (4,924) |
| Corn - Grain | (32,524) | (29,437) | 0 | 0 | (2,243) | 0 | (365) | (441) | 0 | (38) |
| Melons | (294) | (257) | 0 | 0 | 0 | 0 | 0 | (37) | 0 | (0) |
| Oats | 9,326 | 7,360 | 398 | 0 | 1,205 | 109 | (242) | 0 | 479 | 15 |
| Onions | (49) | (48) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (0) |
| Potatoes | (318) | (318) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rice | (5,161) | (2,252) | 0 | 0 | 0 | 0 | (1,308) | (1,602) | 0 | 0 |
| Wild Rice | (5,005) | (5,005) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Safflower | (438) | (336) | 0 | 0 | (25) | 0 | (27) | (54) | 0 | 4 |
| Sorghum | (491) | 0 | 0 | 0 | (228) | 0 | 0 | (262) | 0 | 0 |
| Sugarbeets - internal | 23,787 | 0 | 3,185 | 0 | 11,452 | 875 | 0 | 0 | 3,833 | 4,443 |
| Sudangrass | (16,876) | (16,876) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tomatoes | (1,207) | (1,019) | 0 | 0 | (143) | 0 | (28) | 0 | 0 | (17) |
| Wheat | (7,277) | (6,548) | 0 | 0 | (414) | 0 | (212) | (130) | 0 | 26 |
| Sugarbeets - external | 95,724 | 79,618 | 0 | 0 | 0 | 0 | 3,654 | 12,452 | 0 | 0 |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $40/acre increase in sugarbeet profit**

| 1,538,727 | Acres | 476,419 | 82,923 | 332,839 | 261,446 | 33,975 | 68,548 | 95,470 | 109,203 | 77,903 |
|---|---|---|---|---|---|---|---|---|---|---|
| 4,254,829 | Ac-ft Water | 958,140 | 217,857 | 1,378,289 | 681,790 | 67,185 | 231,009 | 266,351 | 240,880 | 213,329 |
| 2.77 | Ac-ft/Acre | | | | | | | | | |
| | **NCA-ALL** | **NCA-C1** | **NCA-C2** | **NCA-C3** | **NCA-C4** | **NCA-C5** | **NCA-C6** | **NCA-C7** | **NCA-C8** | **NCA-C9** |
| Alfalfa | -0.148% | -0.099% | 0.000% | 0.000% | -0.040% | 0.000% | -0.007% | -0.001% | 0.000% | -0.001% |
| Barley | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -3.770% | -1.518% | -0.233% | 0.000% | -0.584% | -0.064% | -0.088% | -0.683% | -0.280% | -0.320% |
| Corn - Grain | -2.114% | -1.913% | 0.000% | 0.000% | -0.146% | 0.000% | -0.024% | -0.029% | 0.000% | -0.002% |
| Melons | -0.019% | -0.017% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.002% | 0.000% | 0.000% |
| Oats | 0.606% | 0.478% | 0.026% | 0.000% | 0.078% | 0.007% | -0.016% | 0.000% | 0.031% | 0.001% |
| Onions | -0.003% | -0.003% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Potatoes | -0.021% | -0.021% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Rice | -0.335% | -0.146% | 0.000% | 0.000% | 0.000% | 0.000% | -0.085% | -0.104% | 0.000% | 0.000% |
| Wild Rice | -0.325% | -0.325% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Safflower | -0.028% | -0.022% | 0.000% | 0.000% | -0.002% | 0.000% | -0.002% | -0.004% | 0.000% | 0.000% |
| Sorghum | -0.032% | 0.000% | 0.000% | 0.000% | -0.015% | 0.000% | 0.000% | -0.017% | 0.000% | 0.000% |
| Sugarbeets - internal | 1.546% | 0.000% | 0.207% | 0.000% | 0.744% | 0.057% | 0.000% | 0.000% | 0.249% | 0.289% |
| Sudangrass | -1.097% | -1.097% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | -0.078% | -0.066% | 0.000% | 0.000% | -0.009% | 0.000% | -0.002% | 0.000% | 0.000% | -0.001% |
| Wheat | -0.473% | -0.426% | 0.000% | 0.000% | -0.027% | 0.000% | -0.014% | -0.008% | 0.000% | 0.002% |
| Sugarbeets - external | 6.221% | 5.174% | 0.000% | 0.000% | 0.000% | 0.000% | 0.237% | 0.809% | 0.000% | 0.000% |
| Acre-feet of Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $40/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added.

## Table E.7 Acreage change in NCA Region from a $20/acre increase in profit from safflower

**Change in acres from $20/acre increase in safflower profit**

| 1,538,984 | | 476,419 | 82,923 | 332,849 | 261,446 | 33,975 | 68,550 | 95,470 | 109,203 | 78,148 |
|---|---|---|---|---|---|---|---|---|---|---|
| | **NCA-ALL** | **NCA-C1** | **NCA-C2** | **NCA-C3** | **NCA-C4** | **NCA-C5** | **NCA-C6** | **NCA-C7** | **NCA-C8** | **NCA-C9** |
| Alfalfa | 27 | 0 | (0) | 0 | 0 | 0 | 4 | 4 | 0 | 19 |
| Barley | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beans | (2,137) | 0 | (135) | 0 | (173) | (66) | (173) | (1,226) | (177) | (187) |
| Corn - Grain | (9,411) | 0 | 0 | (9,542) | 0 | 0 | 8 | 72 | 0 | 50 |
| Melons | (32) | (0) | 0 | 0 | 0 | 0 | 0 | (30) | 0 | (2) |
| Oats | (4,079) | (1,515) | (583) | 0 | (751) | (286) | (53) | 0 | (767) | (123) |
| Onions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potatoes | (0) | (0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rice | 7,502 | (0) | 0 | 6,809 | 0 | 0 | 82 | 611 | 0 | 0 |
| Wild Rice | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Safflower-internal | 6,562 | 1,929 | 718 | 0 | 925 | 352 | 166 | 1,081 | 944 | 449 |
| Sorghum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sugarbeets | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 |
| Sudangrass | (413) | (413) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tomatoes | 95 | 0 | 0 | 0 | 0 | 0 | 1 | 64 | 0 | 30 |
| Wheat | (2,355) | 0 | 0 | (1,487) | 0 | 0 | (34) | (574) | 0 | (260) |
| Safflower-external | 4,229 | 0 | 0 | 4,229 | 0 | 0 | 0 | 0 | 0 | 0 |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $20/acre increase in safflower profit**

| 1,538,984 | Acres | 476,419 | 82,923 | 332,849 | 261,446 | 33,975 | 68,550 | 95,470 | 109,203 | 78,148 |
|---|---|---|---|---|---|---|---|---|---|---|
| 4,254,829 | Ac-ft Water | 958,140 | 217,857 | 1,378,289 | 681,790 | 67,185 | 231,009 | 266,351 | 240,880 | 213,329 |
| 2.76 | Ac-ft/Acre | | | | | | | | | |
| | **NCA-ALL** | **NCA-C1** | **NCA-C2** | **NCA-C3** | **NCA-C4** | **NCA-C5** | **NCA-C6** | **NCA-C7** | **NCA-C8** | **NCA-C9** |
| Alfalfa | 0.002% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.001% |
| Barley | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -0.139% | 0.000% | -0.009% | 0.000% | -0.011% | -0.004% | -0.011% | -0.080% | -0.011% | -0.012% |
| Corn - Grain | -0.611% | 0.000% | 0.000% | -0.620% | 0.000% | 0.000% | 0.001% | 0.005% | 0.000% | 0.003% |
| Melons | -0.002% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.002% | 0.000% | 0.000% |
| Oats | -0.265% | -0.098% | -0.038% | 0.000% | -0.049% | -0.019% | -0.003% | 0.000% | -0.050% | -0.008% |
| Onions | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Potatoes | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Rice | 0.487% | 0.000% | 0.000% | 0.442% | 0.000% | 0.000% | 0.005% | 0.040% | 0.000% | 0.000% |
| Wild Rice | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Safflower-internal | 0.426% | 0.125% | 0.047% | 0.000% | 0.060% | 0.023% | 0.011% | 0.070% | 0.061% | 0.029% |
| Sorghum | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sugarbeets | 0.002% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.002% |
| Sudangrass | -0.027% | -0.027% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | 0.006% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.004% | 0.000% | 0.002% |
| Wheat | -0.153% | 0.000% | 0.000% | -0.097% | 0.000% | 0.000% | -0.002% | -0.037% | 0.000% | -0.017% |
| Safflower-external | 0.275% | 0.000% | 0.000% | 0.275% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Acre-feet of Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $20/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added.

## Table E.8 Acreage change in NCA Region from a $40/acre increase in profit from safflower

**Change in acres from $40/acre increase in safflower profit**

| Cluster share of region | | 31.0% | 5.4% | 21.6% | 17.0% | 2.2% | 4.5% | 6.2% | 7.1% | 5.1% |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,538,984 | Acres | 476,419 | 82,923 | 332,849 | 261,446 | 33,975 | 68,550 | 95,470 | 109,203 | 78,148 |
| | **NCA-ALL** | **NCA-C1** | **NCA-C2** | **NCA-C3** | **NCA-C4** | **NCA-C5** | **NCA-C6** | **NCA-C7** | **NCA-C8** | **NCA-C9** |
| Alfalfa | 50 | 0 | (0) | 0 | 0 | 0 | 8 | 7 | 0 | 35 |
| Barley | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beans | (4,001) | 0 | (251) | 0 | (323) | (123) | (324) | (2,301) | (330) | (350) |
| Corn - Grain | (9,296) | 0 | 0 | (9,542) | 0 | 0 | 16 | 136 | 0 | 94 |
| Melons | (60) | (0) | 0 | 0 | 0 | 0 | 0 | (56) | 0 | (4) |
| Oats | (7,598) | (2,822) | (1,086) | 0 | (1,399) | (533) | (100) | 0 | (1,428) | (230) |
| Onions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potatoes | (0) | (0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rice | 8,109 | (0) | 0 | 6,809 | 0 | 0 | 153 | 1,146 | 0 | 0 |
| Wild Rice | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Safflower-internal | 12,238 | 3,592 | 1,336 | 0 | 1,722 | 655 | 309 | 2,027 | 1,757 | 838 |
| Sorghum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sugarbeets | 46 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 46 |
| Sudangrass | (770) | (770) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tomatoes | 179 | (0) | 0 | 0 | 0 | 0 | 2 | 120 | 0 | 57 |
| Wheat | (5,865) | (0) | 0 | (4,239) | 0 | 0 | (63) | (1,078) | 0 | (486) |
| Safflower-external | 6,981 | 0 | 0 | 6,981 | 0 | 0 | 0 | 0 | 0 | 0 |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $40/acre increase in safflower profit**

| 1,538,984 | Acres | 476,419 | 82,923 | 332,849 | 261,446 | 33,975 | 68,550 | 95,470 | 109,203 | 78,148 |
|---|---|---|---|---|---|---|---|---|---|---|
| 4,254,829 | Ac-ft Water | 958,140 | 217,857 | 1,378,289 | 681,790 | 67,185 | 231,009 | 266,351 | 240,880 | 213,329 |
| 2.76 | Ac-ft/Acre | | | | | | | | | |
| | NCA-ALL | **NCA-C1** | **NCA-C2** | **NCA-C3** | **NCA-C4** | **NCA-C5** | **NCA-C6** | **NCA-C7** | **NCA-C8** | **NCA-C9** |
| Alfalfa | 0.003% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.001% | 0.000% | 0.000% | 0.002% |
| Barley | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -0.260% | 0.000% | -0.016% | 0.000% | -0.021% | -0.008% | -0.021% | -0.150% | -0.021% | -0.023% |
| Corn - Grain | -0.604% | 0.000% | 0.000% | -0.620% | 0.000% | 0.000% | 0.001% | 0.009% | 0.000% | 0.006% |
| Melons | -0.004% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.004% | 0.000% | 0.000% |
| Oats | -0.494% | -0.183% | -0.071% | 0.000% | -0.091% | -0.035% | -0.007% | 0.000% | -0.093% | -0.015% |
| Onions | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Potatoes | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Rice | 0.527% | 0.000% | 0.000% | 0.442% | 0.000% | 0.000% | 0.010% | 0.074% | 0.000% | 0.000% |
| Wild Rice | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Safflower-internal | 0.795% | 0.233% | 0.087% | 0.000% | 0.112% | 0.043% | 0.020% | 0.132% | 0.114% | 0.054% |
| Sorghum | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sugarbeets | 0.003% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.003% |
| Sudangrass | -0.050% | -0.050% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | 0.012% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.008% | 0.000% | 0.004% |
| Wheat | -0.381% | 0.000% | 0.000% | -0.275% | 0.000% | 0.000% | -0.004% | -0.070% | 0.000% | -0.032% |
| Safflower-external | 0.454% | 0.000% | 0.000% | 0.454% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Acre-feet of Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $40/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added.

## Table E.9 Acreage change in NCA Region from a $20/acre increase in profit from bermudagrass

**Change in acres from $20/acre increase in bermudagrass profit**

| 1,538,971 | Acres | 476,419 | 82,923 | 332,839 | 261,446 | 33,975 | 68,548 | 95,470 | 109,203 | 78,148 |
|---|---|---|---|---|---|---|---|---|---|---|
| | **NCA-ALL** | **NCA-C1** | **NCA-C2** | **NCA-C3** | **NCA-C4** | **NCA-C5** | **NCA-C6** | **NCA-C7** | **NCA-C8** | **NCA-C9** |
| Alfalfa | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Barley | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beans | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Corn - Grain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Melons | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oats | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Onions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potatoes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rice | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wild Rice | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Safflower | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sorghum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sugarbeets | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sudangrass | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tomatoes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wheat | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bermudagrass - exter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $20/acre increase in bermudagrass profit**

| 1,538,971 | Acres | 476,419 | 82,923 | 332,839 | 261,446 | 33,975 | 68,548 | 95,470 | 109,203 | 78,148 |
|---|---|---|---|---|---|---|---|---|---|---|
| 4,254,829 | Ac-ft Water | 958,140 | 217,857 | 1,378,289 | 681,790 | 67,185 | 231,009 | 266,351 | 240,880 | 213,329 |
| 2.76 | Ac-ft/Acre | | | | | | | | | |
| | **NCA-ALL** | **NCA-C1** | **NCA-C2** | **NCA-C3** | **NCA-C4** | **NCA-C5** | **NCA-C6** | **NCA-C7** | **NCA-C8** | **NCA-C9** |
| Alfalfa | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Barley | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Corn - Grain | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Melons | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Oats | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Onions | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Potatoes | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Rice | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Wild Rice | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Safflower | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sorghum | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sugarbeets | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sudangrass | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Wheat | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Bermudagrass - exter | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Acre-feet of Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $20/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added.

## Table E.10 Acreage change in NCA Region from a $40/acre increase in profit from bermudagrass

**Change in acres from $40/acre increase in bermudagrass profit**

| Cluster share of region | | 31.0% | 5.4% | 21.6% | 17.0% | 2.2% | 4.5% | 6.2% | 7.1% | 5.1% |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,538,971 | Acres | 476,419 | 82,923 | 332,839 | 261,446 | 33,975 | 68,548 | 95,470 | 109,203 | 78,148 |
| | **NCA-ALL** | **NCA-C1** | **NCA-C2** | **NCA-C3** | **NCA-C4** | **NCA-C5** | **NCA-C6** | **NCA-C7** | **NCA-C8** | **NCA-C9** |
| Alfalfa | (1,856) | (1,198) | (70) | 0 | (579) | 0 | 0 | 0 | (8) | 0 |
| Barley | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beans | (45,037) | (18,335) | (5,188) | 0 | (7,745) | (4,372) | 0 | 0 | (9,398) | 0 |
| Corn - Grain | (27,159) | (23,110) | (520) | 0 | (2,084) | (213) | 0 | 0 | (1,232) | 0 |
| Melons | (227) | (202) | (6) | 0 | 0 | (5) | 0 | 0 | (14) | 0 |
| Oats | 34,377 | 22,916 | 2,142 | 0 | 3,788 | 1,644 | 0 | 0 | 3,888 | 0 |
| Onions | (44) | (38) | (2) | 0 | 0 | (1) | 0 | 0 | (3) | 0 |
| Potatoes | (263) | (250) | 0 | 0 | 0 | 0 | 0 | 0 | (14) | 0 |
| Rice | (1,834) | (1,768) | 0 | 0 | 0 | (11) | 0 | 0 | (55) | 0 |
| Wild Rice | (3,930) | (3,930) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Safflower | (338) | (264) | (18) | 0 | (23) | (9) | 0 | 0 | (24) | 0 |
| Sorghum | (282) | 0 | 0 | 0 | (212) | 0 | 0 | 0 | (70) | 0 |
| Sugarbeets | (1,365) | 0 | (215) | 0 | (832) | (59) | 0 | 0 | (259) | 0 |
| Sudangrass | (16,876) | (16,876) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tomatoes | (1,427) | (800) | (205) | 0 | (133) | (105) | 0 | 0 | (184) | 0 |
| Wheat | (6,278) | (5,141) | (228) | 0 | (384) | (120) | 0 | 0 | (406) | 0 |
| Bermudagrass - exter | 72,538 | 48,994 | 4,310 | 0 | 8,204 | 3,251 | 0 | 0 | 7,779 | 0 |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $40/acre increase in bermudagrass profit**

| 1,538,971 | Acres | 476,419 | 82,923 | 332,839 | 261,446 | 33,975 | 68,548 | 95,470 | 109,203 | 78,148 |
|---|---|---|---|---|---|---|---|---|---|---|
| 4,254,829 | Ac-ft Water | 958,140 | 217,857 | 1,378,289 | 681,790 | 67,185 | 231,009 | 266,351 | 240,880 | 213,329 |
| 2.76 | Ac-ft/Acre | | | | | | | | | |
| | **NCA-ALL** | **NCA-C1** | **NCA-C2** | **NCA-C3** | **NCA-C4** | **NCA-C5** | **NCA-C6** | **NCA-C7** | **NCA-C8** | **NCA-C9** |
| Alfalfa | -0.121% | -0.078% | -0.005% | 0.000% | -0.038% | 0.000% | 0.000% | 0.000% | -0.001% | 0.000% |
| Barley | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -2.926% | -1.191% | -0.337% | 0.000% | -0.503% | -0.284% | 0.000% | 0.000% | -0.611% | 0.000% |
| Corn - Grain | -1.765% | -1.502% | -0.034% | 0.000% | -0.135% | -0.014% | 0.000% | 0.000% | -0.080% | 0.000% |
| Melons | -0.015% | -0.013% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.001% | 0.000% |
| Oats | 2.234% | 1.489% | 0.139% | 0.000% | 0.246% | 0.107% | 0.000% | 0.000% | 0.253% | 0.000% |
| Onions | -0.003% | -0.002% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Potatoes | -0.017% | -0.016% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.001% | 0.000% |
| Rice | -0.119% | -0.115% | 0.000% | 0.000% | 0.000% | -0.001% | 0.000% | 0.000% | -0.004% | 0.000% |
| Wild Rice | -0.255% | -0.255% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Safflower | -0.022% | -0.017% | -0.001% | 0.000% | -0.002% | -0.001% | 0.000% | 0.000% | -0.002% | 0.000% |
| Sorghum | -0.018% | 0.000% | 0.000% | 0.000% | -0.014% | 0.000% | 0.000% | 0.000% | -0.005% | 0.000% |
| Sugarbeets | -0.089% | 0.000% | -0.014% | 0.000% | -0.054% | -0.004% | 0.000% | 0.000% | -0.017% | 0.000% |
| Sudangrass | -1.097% | -1.097% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | -0.093% | -0.052% | -0.013% | 0.000% | -0.009% | -0.007% | 0.000% | 0.000% | -0.012% | 0.000% |
| Wheat | -0.408% | -0.334% | -0.015% | 0.000% | -0.025% | -0.008% | 0.000% | 0.000% | -0.026% | 0.000% |
| Bermudagrass - exter | 4.713% | 3.184% | 0.280% | 0.000% | 0.533% | 0.211% | 0.000% | 0.000% | 0.505% | 0.000% |
| Acre-feet of Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $40/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added.

## Table E.11 Acreage changes in CEN Region from a $20/acre increase in profit from canola

**Change in acres from $20/acre increase in bermudagrass profit**

| 1,148,378 | Acres | 208,607 | 339,367 | 154,841 | 99,985 | 17,373 | 64,315 | 92,803 | 35,161 | 135,926 |
|---|---|---|---|---|---|---|---|---|---|---|
| | **CEN-ALL** | **CEN-C1** | **CEN-C2** | **CEN-C3** | **CEN-C4** | **CEN-C5** | **CEN-C6** | **CEN-C7** | **CEN-C8** | **CEN-C9** |
| Alfalfa | 631 | 53 | 0 | 301 | 0 | 0 | 18 | 241 | 18 | 0 |
| Barley | (1,341) | 0 | 0 | 0 | 0 | 0 | (1,341) | 0 | 0 | 0 |
| Beans | (118) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (118) | 0 |
| Broccoli | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Corn-Silage | 2,279 | 0 | 0 | 860 | 0 | 0 | 68 | 1,287 | 64 | 0 |
| Cotton | (22,889) | (688) | 0 | (12,216) | 0 | 0 | (7,410) | (2,575) | 0 | 0 |
| Garlic | 32 | 31 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| Lettuce | (183) | (164) | 0 | 0 | 0 | 0 | (19) | 0 | 0 | 0 |
| Melons | (78) | (48) | 0 | 0 | 0 | 0 | (14) | (16) | 0 | 0 |
| Oats | (677) | 0 | 0 | (541) | 0 | 0 | 0 | 0 | (135) | 0 |
| Onions | 14 | 13 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Rice | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sugarbeet | 13,477 | 0 | 0 | 7,872 | 0 | 0 | 5,605 | 0 | 0 | 0 |
| Tomatoes | 450 | 356 | 0 | 0 | 0 | 0 | 5 | 86 | 3 | 0 |
| Wheat | (1,609) | (386) | 0 | (524) | 0 | 0 | (549) | (149) | 0 | 0 |
| Canola | 10,017 | 835 | 0 | 4,250 | 0 | 0 | 3,636 | 1,128 | 168 | 0 |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $20/acre increase in canola profit**

| 1,148,378 | Acres | 208,607 | 339,367 | 154,841 | 99,985 | 17,373 | 64,315 | 92,803 | 35,161 | 135,926 |
|---|---|---|---|---|---|---|---|---|---|---|
| 3,461,214 | Ac-ft Water | 581,088 | 929,124 | 483,169 | 328,980 | 141,187 | 156,120 | 295,681 | 117,946 | 427,920 |
| 3.01 | Ac-ft/Acre | | | | | | | | | |
| | **CEN-ALL** | **CEN-C1** | **CEN-C2** | **CEN-C3** | **CEN-C4** | **CEN-C5** | **CEN-C6** | **CEN-C7** | **CEN-C8** | **CEN-C9** |
| Alfalfa | 0.055% | 0.005% | 0.000% | 0.026% | 0.000% | 0.000% | 0.002% | 0.021% | 0.002% | 0.000% |
| Barley | -0.117% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.117% | 0.000% | 0.000% | 0.000% |
| Beans | -0.010% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.010% | 0.000% |
| Broccoli | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Corn-Silage | 0.198% | 0.000% | 0.000% | 0.075% | 0.000% | 0.000% | 0.006% | 0.112% | 0.006% | 0.000% |
| Cotton | -1.993% | -0.060% | 0.000% | -1.064% | 0.000% | 0.000% | -0.645% | -0.224% | 0.000% | 0.000% |
| Garlic | 0.003% | 0.003% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Lettuce | -0.016% | -0.014% | 0.000% | 0.000% | 0.000% | 0.000% | -0.002% | 0.000% | 0.000% | 0.000% |
| Melons | -0.007% | -0.004% | 0.000% | 0.000% | 0.000% | 0.000% | -0.001% | -0.001% | 0.000% | 0.000% |
| Oats | -0.059% | 0.000% | 0.000% | -0.047% | 0.000% | 0.000% | 0.000% | 0.000% | -0.012% | 0.000% |
| Onions | 0.001% | 0.001% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Rice | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sugarbeet | 1.174% | 0.000% | 0.000% | 0.685% | 0.000% | 0.000% | 0.488% | 0.000% | 0.000% | 0.000% |
| Tomatoes | 0.039% | 0.031% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.008% | 0.000% | 0.000% |
| Wheat | -0.140% | -0.034% | 0.000% | -0.046% | 0.000% | 0.000% | -0.048% | -0.013% | 0.000% | 0.000% |
| Canola | 0.872% | 0.073% | 0.000% | 0.370% | 0.000% | 0.000% | 0.317% | 0.098% | 0.015% | 0.000% |
| Acre-feet of Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $20/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.

## Table E.12 Acreage change in CEN Region from a $40/acre increase in profit from canola

**Change in acres from $40/acre increase in canola profit**

| Cluster share of region | | 18.2% | 29.6% | 13.5% | 8.7% | 1.5% | 5.6% | 8.1% | 3.1% | 11.8% |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,148,378 | Acres | 208,607 | 339,367 | 154,841 | 99,985 | 17,373 | 64,315 | 92,803 | 35,161 | 135,926 |
| | **CEN-ALL** | **CEN-C1** | **CEN-C2** | **CEN-C3** | **CEN-C4** | **CEN-C5** | **CEN-C6** | **CEN-C7** | **CEN-C8** | **CEN-C9** |
| Alfalfa | 2,736 | 200 | 348 | 1,091 | 0 | 0 | 66 | 912 | 119 | 0 |
| Barley | (1,341) | 0 | 0 | 0 | 0 | 0 | (1,341) | 0 | 0 | 0 |
| Beans | (1,553) | 0 | (760) | 0 | 0 | 0 | 0 | 0 | (793) | 0 |
| Broccoli | (118) | 0 | (118) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Corn-Silage | 9,961 | 0 | 1,563 | 3,114 | 0 | 0 | 250 | 4,601 | 433 | 0 |
| Cotton | (239,242) | (80,143) | (55,335) | (44,242) | 0 | 0 | (27,342) | (32,180) | 0 | 0 |
| Garlic | 118 | 112 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 |
| Lettuce | (773) | (701) | 0 | 0 | 0 | 0 | (71) | 0 | 0 | 0 |
| Melons | (555) | (225) | (204) | 0 | 0 | 0 | (51) | (74) | 0 | 0 |
| Oats | (18,989) | 0 | (16,118) | (1,961) | 0 | 0 | 0 | 0 | (910) | 0 |
| Onions | 57 | 47 | 7 | 0 | 0 | 0 | 3 | 0 | 0 | 0 |
| Rice | 3,908 | 0 | 3,908 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sugarbeet | 78,026 | 0 | 29,006 | 28,509 | 0 | 0 | 20,511 | 0 | 0 | 0 |
| Tomatoes | 1,725 | 1,298 | 74 | 0 | 0 | 0 | 17 | 315 | 20 | 0 |
| Wheat | (9,796) | (1,626) | (3,614) | (1,899) | 0 | 0 | (2,027) | (630) | 0 | 0 |
| Canola | 175,842 | 81,042 | 41,243 | 15,388 | 0 | 0 | 9,980 | 27,058 | 1,131 | 0 |
| Acre-feet of Water | (160,895) | (124,291) | 0 | 0 | 0 | 0 | 0 | (36,604) | 0 | 0 |

**Percent regional change in cluster acreage from $40/acre increase in canola profit**

| 1,148,378 | Acres | 208,607 | 339,367 | 154,841 | 99,985 | 17,373 | 64,315 | 92,803 | 35,161 | 135,926 |
|---|---|---|---|---|---|---|---|---|---|---|
| 3,300,318 | Ac-ft Water | 456,796 | 929,124 | 483,169 | 328,980 | 141,187 | 156,120 | 259,077 | 117,946 | 427,920 |
| 2.87 | Ac-ft/Acre | | | | | | | | | |
| | **CEN-ALL** | **CEN-C1** | **CEN-C2** | **CEN-C3** | **CEN-C4** | **CEN-C5** | **CEN-C6** | **CEN-C7** | **CEN-C8** | **CEN-C9** |
| Alfalfa | 0.238% | 0.017% | 0.030% | 0.095% | 0.000% | 0.000% | 0.006% | 0.079% | 0.010% | 0.000% |
| Barley | -0.117% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.117% | 0.000% | 0.000% | 0.000% |
| Beans | -0.135% | 0.000% | -0.066% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.069% | 0.000% |
| Broccoli | -0.010% | 0.000% | -0.010% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Corn-Silage | 0.867% | 0.000% | 0.136% | 0.271% | 0.000% | 0.000% | 0.022% | 0.401% | 0.038% | 0.000% |
| Cotton | -20.833% | -6.979% | -4.819% | -3.853% | 0.000% | 0.000% | -2.381% | -2.802% | 0.000% | 0.000% |
| Garlic | 0.010% | 0.010% | 0.000% | 0.000% | 0.000% | 0.000% | 0.001% | 0.000% | 0.000% | 0.000% |
| Lettuce | -0.067% | -0.061% | 0.000% | 0.000% | 0.000% | 0.000% | -0.006% | 0.000% | 0.000% | 0.000% |
| Melons | -0.048% | -0.020% | -0.018% | 0.000% | 0.000% | 0.000% | -0.004% | -0.006% | 0.000% | 0.000% |
| Oats | -1.654% | 0.000% | -1.404% | -0.171% | 0.000% | 0.000% | 0.000% | 0.000% | -0.079% | 0.000% |
| Onions | 0.005% | 0.004% | 0.001% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Rice | 0.340% | 0.000% | 0.340% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sugarbeet | 6.794% | 0.000% | 2.526% | 2.483% | 0.000% | 0.000% | 1.786% | 0.000% | 0.000% | 0.000% |
| Tomatoes | 0.150% | 0.113% | 0.006% | 0.000% | 0.000% | 0.000% | 0.001% | 0.027% | 0.002% | 0.000% |
| Wheat | -0.853% | -0.142% | -0.315% | -0.165% | 0.000% | 0.000% | -0.176% | -0.055% | 0.000% | 0.000% |
| Canola | 15.312% | 7.057% | 3.591% | 1.340% | 0.000% | 0.000% | 0.869% | 2.356% | 0.098% | 0.000% |
| Acre-feet of Water | -4.875% | -3.766% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -1.109% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $40/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.

## Table E.13 Acreage change in CEN Region from a $20/acre increase in profit from sweet sorghum

**Change in acres from $20/acre increase in sweet sorghum profit**

| 1,148,372 | Acres | 208,605 | 339,367 | 154,840 | 99,985 | 17,373 | 64,315 | 92,801 | 35,161 | 135,926 |
|---|---|---|---|---|---|---|---|---|---|---|
| | **CEN-ALL** | **CEN-C1** | **CEN-C2** | **CEN-C3** | **CEN-C4** | **CEN-C5** | **CEN-C6** | **CEN-C7** | **CEN-C8** | **CEN-C9** |
| Alfalfa | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Barley | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beans | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Broccoli | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Corn-Silage | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cotton | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Garlic | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lettuce | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Melons | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oats | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Onions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rice | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sugarbeet | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tomatoes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wheat | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sweet Sorghum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $20/acre increase in sweet sorghum profit**

| 1,148,372 | Acres | 208,605 | 339,367 | 154,840 | 99,985 | 17,373 | 64,315 | 92,801 | 35,161 | 135,926 |
|---|---|---|---|---|---|---|---|---|---|---|
| 3,461,214 | Ac-ft Water | 581,088 | 929,124 | 483,169 | 328,980 | 141,187 | 156,120 | 295,681 | 117,946 | 427,920 |
| 3.01 | Ac-ft/Acre | | | | | | | | | |
| | **CEN-ALL** | **CEN-C1** | **CEN-C2** | **CEN-C3** | **CEN-C4** | **CEN-C5** | **CEN-C6** | **CEN-C7** | **CEN-C8** | **CEN-C9** |
| Alfalfa | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Barley | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Broccoli | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Corn-Silage | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Cotton | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Garlic | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Lettuce | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Melons | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Oats | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Onions | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Rice | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sugarbeet | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Wheat | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sweet Sorghum | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Acre-feet of Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $20/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.

## Table E.14 Acreage change in CEN Region from a $40/acre increase in profit from sweet sorghum

**Change in acres from $40/acre increase in sweet sorghum profit**

| Cluster share of region | | 18.2% | 29.6% | 13.5% | 8.7% | 1.5% | 5.5% | 8.1% | 3.1% | 11.8% |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,147,753 | Acres | 208,605 | 339,367 | 154,841 | 99,985 | 17,373 | 63,696 | 92,801 | 35,161 | 135,926 |
| | **CEN-ALL** | **CEN-C1** | **CEN-C2** | **CEN-C3** | **CEN-C4** | **CEN-C5** | **CEN-C6** | **CEN-C7** | **CEN-C8** | **CEN-C9** |
| Alfalfa | (135) | 0 | 0 | (121) | 0 | 0 | (14) | 0 | 0 | 0 |
| Barley | (1,341) | 0 | 0 | 0 | 0 | 0 | (1,341) | 0 | 0 | 0 |
| Beans | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Broccoli | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Corn-Silage | (1,482) | 0 | 0 | (1,336) | 0 | 0 | (145) | 0 | 0 | 0 |
| Cotton | (21,381) | 0 | 0 | (13,799) | 0 | 0 | (7,582) | 0 | 0 | 0 |
| Garlic | (2) | 0 | 0 | 0 | 0 | 0 | (2) | 0 | 0 | 0 |
| Lettuce | (2) | 0 | 0 | 0 | 0 | 0 | (2) | 0 | 0 | 0 |
| Melons | (5) | 0 | 0 | 0 | 0 | 0 | (5) | 0 | 0 | 0 |
| Oats | (178) | 0 | 0 | (178) | 0 | 0 | 0 | 0 | 0 | 0 |
| Onions | (2) | 0 | 0 | 0 | 0 | 0 | (2) | 0 | 0 | 0 |
| Rice | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sugarbeet | (14,733) | 0 | 0 | (7,821) | 0 | 0 | (6,912) | 0 | 0 | 0 |
| Tomatoes | (7) | 0 | 0 | 0 | 0 | 0 | (7) | 0 | 0 | 0 |
| Wheat | (201) | 0 | 0 | (166) | 0 | 0 | (35) | 0 | 0 | 0 |
| Sweet Sorghum | 38,851 | 0 | 0 | 23,422 | 0 | 0 | 15,429 | 0 | 0 | 0 |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $40/acre increase in sweet sorghum profit**

| 1,147,753 | Acres | 208,605 | 339,367 | 154,841 | 99,985 | 17,373 | 63,696 | 92,801 | 35,161 | 135,926 |
|---|---|---|---|---|---|---|---|---|---|---|
| 3,461,214 | Ac-ft Water | 581,088 | 929,124 | 483,169 | 328,980 | 141,187 | 156,120 | 295,681 | 117,946 | 427,920 |
| 3.02 | Ac-ft/Acre | | | | | | | | | |
| | **CEN-ALL** | **CEN-C1** | **CEN-C2** | **CEN-C3** | **CEN-C4** | **CEN-C5** | **CEN-C6** | **CEN-C7** | **CEN-C8** | **CEN-C9** |
| Alfalfa | -0.012% | 0.000% | 0.000% | -0.011% | 0.000% | 0.000% | -0.001% | 0.000% | 0.000% | 0.000% |
| Barley | -0.117% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.117% | 0.000% | 0.000% | 0.000% |
| Beans | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Broccoli | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Corn-Silage | -0.129% | 0.000% | 0.000% | -0.116% | 0.000% | 0.000% | -0.013% | 0.000% | 0.000% | 0.000% |
| Cotton | -1.863% | 0.000% | 0.000% | -1.202% | 0.000% | 0.000% | -0.661% | 0.000% | 0.000% | 0.000% |
| Garlic | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Lettuce | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Melons | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Oats | -0.016% | 0.000% | 0.000% | -0.016% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Onions | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Rice | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sugarbeet | -1.284% | 0.000% | 0.000% | -0.681% | 0.000% | 0.000% | -0.602% | 0.000% | 0.000% | 0.000% |
| Tomatoes | -0.001% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.001% | 0.000% | 0.000% | 0.000% |
| Wheat | -0.018% | 0.000% | 0.000% | -0.014% | 0.000% | 0.000% | -0.003% | 0.000% | 0.000% | 0.000% |
| Sweet Sorghum | 3.385% | 0.000% | 0.000% | 2.041% | 0.000% | 0.000% | 1.344% | 0.000% | 0.000% | 0.000% |
| Acre-feet of Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $40/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.

## Table E.15 Acreage change in CEN Region from a $20/acre increase in profit from sugarbeets

**Change in acres from $20/acre increase in sugarbeet profit**

| 1,134,970 | Acres | 208,605 | 339,367 | 147,857 | 99,985 | 17,373 | 57,897 | 92,801 | 35,161 | 135,926 |
|---|---|---|---|---|---|---|---|---|---|---|
| | **CEN-ALL** | **CEN-C1** | **CEN-C2** | **CEN-C3** | **CEN-C4** | **CEN-C5** | **CEN-C6** | **CEN-C7** | **CEN-C8** | **CEN-C9** |
| Alfalfa | (3,994) | 0 | (1,597) | (2,265) | 0 | 0 | (131) | 0 | 0 | 0 |
| Barley | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beans | (7,133) | 0 | (7,133) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Broccoli | (254) | 0 | (254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Corn-Silage | (37,953) | 0 | (19,384) | (17,203) | 0 | 0 | (1,366) | 0 | 0 | 0 |
| Cotton | (158,841) | 0 | (63,688) | (57,026) | 0 | 0 | (38,127) | 0 | 0 | 0 |
| Garlic | (22) | 0 | 0 | 0 | 0 | 0 | (22) | 0 | 0 | 0 |
| Lettuce | (23) | 0 | 0 | 0 | 0 | 0 | (23) | 0 | 0 | 0 |
| Melons | (494) | 0 | (441) | 0 | 0 | 0 | (52) | 0 | 0 | 0 |
| Oats | (5,888) | 0 | (5,672) | (216) | 0 | 0 | 0 | 0 | 0 | 0 |
| Onions | (107) | 0 | (92) | 0 | 0 | 0 | (15) | 0 | 0 | 0 |
| Rice | (8,821) | 0 | (8,821) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sugarbeet - internal | 212,291 | 0 | 108,687 | 69,864 | 0 | 0 | 33,741 | 0 | 0 | 0 |
| Tomatoes | (709) | 0 | (644) | 0 | 0 | 0 | (64) | 0 | 0 | 0 |
| Wheat | (1,455) | 0 | (961) | (137) | 0 | 0 | (357) | 0 | 0 | 0 |
| Sugarbeet - external | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $20/acre increase in sugarbeet profit**

| 1,134,970 | Acres | 208,605 | 339,367 | 147,857 | 99,985 | 17,373 | 57,897 | 92,801 | 35,161 | 135,926 |
|---|---|---|---|---|---|---|---|---|---|---|
| 3,461,214 | Ac-ft Water | 581,088 | 929,124 | 483,169 | 328,980 | 141,187 | 156,120 | 295,681 | 117,946 | 427,920 |
| 3.05 | Ac-ft/Acre | | | | | | | | | |
| | **CEN-ALL** | **CEN-C1** | **CEN-C2** | **CEN-C3** | **CEN-C4** | **CEN-C5** | **CEN-C6** | **CEN-C7** | **CEN-C8** | **CEN-C9** |
| Alfalfa | -0.352% | 0.000% | -0.141% | -0.200% | 0.000% | 0.000% | -0.012% | 0.000% | 0.000% | 0.000% |
| Barley | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -0.628% | 0.000% | -0.628% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Broccoli | -0.022% | 0.000% | -0.022% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Corn-Silage | -3.344% | 0.000% | -1.708% | -1.516% | 0.000% | 0.000% | -0.120% | 0.000% | 0.000% | 0.000% |
| Cotton | -13.995% | 0.000% | -5.611% | -5.024% | 0.000% | 0.000% | -3.359% | 0.000% | 0.000% | 0.000% |
| Garlic | -0.002% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.002% | 0.000% | 0.000% | 0.000% |
| Lettuce | -0.002% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.002% | 0.000% | 0.000% | 0.000% |
| Melons | -0.043% | 0.000% | -0.039% | 0.000% | 0.000% | 0.000% | -0.005% | 0.000% | 0.000% | 0.000% |
| Oats | -0.519% | 0.000% | -0.500% | -0.019% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Onions | -0.009% | 0.000% | -0.008% | 0.000% | 0.000% | 0.000% | -0.001% | 0.000% | 0.000% | 0.000% |
| Rice | -0.777% | 0.000% | -0.777% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sugarbeet - internal | 18.705% | 0.000% | 9.576% | 6.156% | 0.000% | 0.000% | 2.973% | 0.000% | 0.000% | 0.000% |
| Tomatoes | -0.062% | 0.000% | -0.057% | 0.000% | 0.000% | 0.000% | -0.006% | 0.000% | 0.000% | 0.000% |
| Wheat | -0.128% | 0.000% | -0.085% | -0.012% | 0.000% | 0.000% | -0.031% | 0.000% | 0.000% | 0.000% |
| Sugarbeet - external | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Acre-feet of Water | -1.181% | 0.000% | 0.000% | -0.615% | 0.000% | 0.000% | -0.566% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $20/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added.

## Table E.16 Acreage change in CEN Region from a $40/acre increase in profit from sugarbeets

**Change in acres from $40/acre increase in sugarbeet profit**

| Cluster share of region | | 18.4% | 29.9% | 13.1% | 8.8% | 1.5% | 5.1% | 8.2% | 3.1% | 12.0% |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,135,655 | Acres | 208,605 | 339,367 | 148,755 | 99,985 | 17,373 | 57,684 | 92,801 | 35,161 | 135,926 |
| | **CEN-ALL** | **CEN-C1** | **CEN-C2** | **CEN-C3** | **CEN-C4** | **CEN-C5** | **CEN-C6** | **CEN-C7** | **CEN-C8** | **CEN-C9** |
| Alfalfa | (7,501) | 0 | (3,040) | (4,211) | 0 | 0 | (250) | 0 | 0 | 0 |
| Barley | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beans | (14,763) | 0 | (14,763) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Broccoli | (572) | 0 | (572) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Corn-Silage | (58,245) | 0 | (32,242) | (24,078) | 0 | 0 | (1,925) | 0 | 0 | 0 |
| Cotton | (158,841) | 0 | (63,688) | (57,026) | 0 | 0 | (38,127) | 0 | 0 | 0 |
| Garlic | (42) | 0 | 0 | 0 | 0 | 0 | (42) | 0 | 0 | 0 |
| Lettuce | (49) | 0 | 0 | 0 | 0 | 0 | (49) | 0 | 0 | 0 |
| Melons | (1,098) | 0 | (994) | 0 | 0 | 0 | (104) | 0 | 0 | 0 |
| Oats | (20,423) | 0 | (19,723) | (701) | 0 | 0 | 0 | 0 | 0 | 0 |
| Onions | (211) | 0 | (182) | 0 | 0 | 0 | (29) | 0 | 0 | 0 |
| Rice | (15,761) | 0 | (15,761) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sugarbeet - internal | 271,295 | 0 | 156,019 | 80,469 | 0 | 0 | 34,807 | 0 | 0 | 0 |
| Tomatoes | (1,383) | 0 | (1,259) | 0 | 0 | 0 | (124) | 0 | 0 | 0 |
| Wheat | (5,125) | 0 | (3,796) | (539) | 0 | 0 | (789) | 0 | 0 | 0 |
| Sugarbeet - external | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $40/acre increase in sugarbeet profit**

| 1,135,655 | Acres | 208,605 | 339,367 | 148,755 | 99,985 | 17,373 | 57,684 | 92,801 | 35,161 | 135,926 |
|---|---|---|---|---|---|---|---|---|---|---|
| 3,461,214 | Ac-ft Water | 581,088 | 929,124 | 483,169 | 328,980 | 141,187 | 156,120 | 295,681 | 117,946 | 427,920 |
| 3.05 | Ac-ft/Acre | | | | | | | | | |
| | **CEN-ALL** | **CEN-C1** | **CEN-C2** | **CEN-C3** | **CEN-C4** | **CEN-C5** | **CEN-C6** | **CEN-C7** | **CEN-C8** | **CEN-C9** |
| Alfalfa | -0.660% | 0.000% | -0.268% | -0.371% | 0.000% | 0.000% | -0.022% | 0.000% | 0.000% | 0.000% |
| Barley | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -1.300% | 0.000% | -1.300% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Broccoli | -0.050% | 0.000% | -0.050% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Corn-Silage | -5.129% | 0.000% | -2.839% | -2.120% | 0.000% | 0.000% | -0.169% | 0.000% | 0.000% | 0.000% |
| Cotton | -13.987% | 0.000% | -5.608% | -5.021% | 0.000% | 0.000% | -3.357% | 0.000% | 0.000% | 0.000% |
| Garlic | -0.004% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.004% | 0.000% | 0.000% | 0.000% |
| Lettuce | -0.004% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.004% | 0.000% | 0.000% | 0.000% |
| Melons | -0.097% | 0.000% | -0.088% | 0.000% | 0.000% | 0.000% | -0.009% | 0.000% | 0.000% | 0.000% |
| Oats | -1.798% | 0.000% | -1.737% | -0.062% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Onions | -0.019% | 0.000% | -0.016% | 0.000% | 0.000% | 0.000% | -0.003% | 0.000% | 0.000% | 0.000% |
| Rice | -1.388% | 0.000% | -1.388% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sugarbeet - internal | 23.889% | 0.000% | 13.738% | 7.086% | 0.000% | 0.000% | 3.065% | 0.000% | 0.000% | 0.000% |
| Tomatoes | -0.122% | 0.000% | -0.111% | 0.000% | 0.000% | 0.000% | -0.011% | 0.000% | 0.000% | 0.000% |
| Wheat | -0.451% | 0.000% | -0.334% | -0.047% | 0.000% | 0.000% | -0.070% | 0.000% | 0.000% | 0.000% |
| Sugarbeet - external | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Acre-feet of Water | -1.120% | 0.000% | 0.000% | -0.536% | 0.000% | 0.000% | -0.584% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $40/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added.

## Table E.17 Acreage change in CEN Region from a $20/acre increase in profit from safflower

**Change in acres from $20/acre increase in safflower profit**

| 1,148,378 | Acres | 208,607 | 339,367 | 154,841 | 99,985 | 17,373 | 64,315 | 92,803 | 35,161 | 135,926 |
|---|---|---|---|---|---|---|---|---|---|---|
| | **CEN-ALL** | **CEN-C1** | **CEN-C2** | **CEN-C3** | **CEN-C4** | **CEN-C5** | **CEN-C6** | **CEN-C7** | **CEN-C8** | **CEN-C9** |
| Alfalfa | 1,132 | 98 | 0 | 503 | 0 | 0 | 30 | 446 | 56 | 0 |
| Barley | (1,341) | 0 | 0 | 0 | 0 | 0 | (1,341) | 0 | 0 | 0 |
| Beans | (373) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (373) | 0 |
| Broccoli | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Corn-Silage | 4,208 | 0 | 0 | 1,435 | 0 | 0 | 114 | 2,380 | 279 | 0 |
| Cotton | (38,187) | (962) | 0 | (20,386) | 0 | 0 | (12,494) | (4,344) | 0 | 0 |
| Garlic | 59 | 57 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 |
| Lettuce | (336) | (303) | 0 | 0 | 0 | 0 | (33) | 0 | 0 | 0 |
| Melons | (141) | (89) | 0 | 0 | 0 | 0 | (24) | (29) | 0 | 0 |
| Oats | (1,331) | 0 | 0 | (904) | 0 | 0 | 0 | 0 | (428) | 0 |
| Onions | 26 | 24 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Rice | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sugarbeets | 24,520 | 0 | 0 | 14,271 | 0 | 0 | 10,248 | 0 | 0 | 0 |
| Tomatoes | 835 | 658 | 0 | 0 | 0 | 0 | 8 | 160 | 10 | 0 |
| Wheat | (2,791) | (713) | 0 | (875) | 0 | 0 | (926) | (276) | 0 | 0 |
| Safflower - external | 13,726 | 1,233 | 0 | 5,957 | 0 | 0 | 4,413 | 1,666 | 456 | 0 |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $20/acre increase in safflower profit**

| 1,148,378 | Acres | 208,607 | 339,367 | 154,841 | 99,985 | 17,373 | 64,315 | 92,803 | 35,161 | 135,926 |
|---|---|---|---|---|---|---|---|---|---|---|
| 3,461,214 | Ac-ft Water | 581,088 | 929,124 | 483,169 | 328,980 | 141,187 | 156,120 | 295,681 | 117,946 | 427,920 |
| 3.01 | Ac-ft/Acre | | | | | | | | | |
| | **CEN-ALL** | **CEN-C1** | **CEN-C2** | **CEN-C3** | **CEN-C4** | **CEN-C5** | **CEN-C6** | **CEN-C7** | **CEN-C8** | **CEN-C9** |
| Alfalfa | 0.099% | 0.008% | 0.000% | 0.044% | 0.000% | 0.000% | 0.003% | 0.039% | 0.005% | 0.000% |
| Barley | -0.117% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.117% | 0.000% | 0.000% | 0.000% |
| Beans | -0.032% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.032% | 0.000% |
| Broccoli | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Corn-Silage | 0.366% | 0.000% | 0.000% | 0.125% | 0.000% | 0.000% | 0.010% | 0.207% | 0.024% | 0.000% |
| Cotton | -3.325% | -0.084% | 0.000% | -1.775% | 0.000% | 0.000% | -1.088% | -0.378% | 0.000% | 0.000% |
| Garlic | 0.005% | 0.005% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Lettuce | -0.029% | -0.026% | 0.000% | 0.000% | 0.000% | 0.000% | -0.003% | 0.000% | 0.000% | 0.000% |
| Melons | -0.012% | -0.008% | 0.000% | 0.000% | 0.000% | 0.000% | -0.002% | -0.003% | 0.000% | 0.000% |
| Oats | -0.116% | 0.000% | 0.000% | -0.079% | 0.000% | 0.000% | 0.000% | 0.000% | -0.037% | 0.000% |
| Onions | 0.002% | 0.002% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Rice | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sugarbeets | 2.135% | 0.000% | 0.000% | 1.243% | 0.000% | 0.000% | 0.892% | 0.000% | 0.000% | 0.000% |
| Tomatoes | 0.073% | 0.057% | 0.000% | 0.000% | 0.000% | 0.000% | 0.001% | 0.014% | 0.001% | 0.000% |
| Wheat | -0.243% | -0.062% | 0.000% | -0.076% | 0.000% | 0.000% | -0.081% | -0.024% | 0.000% | 0.000% |
| Safflower - external | 1.195% | 0.107% | 0.000% | 0.519% | 0.000% | 0.000% | 0.384% | 0.145% | 0.040% | 0.000% |
| Acre-feet of Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $20/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added.

## Table E.18 Acreage change in CEN Region from a $40/acre increase in profit from safflower

**Change in acres from $40/acre increase in safflower profit**

| Cluster share of region | | 18.2% | 29.6% | 13.5% | 8.7% | 1.5% | 5.6% | 8.1% | 3.1% | 11.8% |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,148,378 | Acres | 208,607 | 339,367 | 154,841 | 99,985 | 17,373 | 64,315 | 92,803 | 35,161 | 135,926 |
| | **CEN-ALL** | **CEN-C1** | **CEN-C2** | **CEN-C3** | **CEN-C4** | **CEN-C5** | **CEN-C6** | **CEN-C7** | **CEN-C8** | **CEN-C9** |
| Alfalfa | 2,794 | 190 | 386 | 1,140 | 0 | 0 | 69 | 869 | 139 | 0 |
| Barley | (1,341) | 0 | 0 | 0 | 0 | 0 | (1,341) | 0 | 0 | 0 |
| Beans | (1,774) | 0 | (844) | 0 | 0 | 0 | 0 | 0 | (930) | 0 |
| Broccoli | (131) | 0 | (131) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Corn-Silage | 10,090 | 0 | 1,735 | 3,252 | 0 | 0 | 261 | 4,146 | 695 | 0 |
| Cotton | (242,437) | (80,143) | (55,335) | (46,211) | 0 | 0 | (28,568) | (32,180) | 0 | 0 |
| Garlic | 109 | 103 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 |
| Lettuce | (814) | (740) | 0 | 0 | 0 | 0 | (74) | 0 | 0 | 0 |
| Melons | (618) | (254) | (227) | 0 | 0 | 0 | (54) | (83) | 0 | 0 |
| Oats | (21,008) | 0 | (17,893) | (2,048) | 0 | 0 | 0 | 0 | (1,067) | 0 |
| Onions | 53 | 42 | 8 | 0 | 0 | 0 | 3 | 0 | 0 | 0 |
| Rice | 4,338 | 0 | 4,338 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sugarbeets | 90,088 | 0 | 34,651 | 32,350 | 0 | 0 | 23,087 | 0 | 0 | 0 |
| Tomatoes | 1,607 | 1,194 | 82 | 0 | 0 | 0 | 18 | 290 | 24 | 0 |
| Wheat | (10,467) | (1,697) | (4,012) | (1,984) | 0 | 0 | (2,118) | (657) | 0 | 0 |
| Safflower - external | 169,059 | 81,307 | 37,240 | 13,501 | 0 | 0 | 8,711 | 27,618 | 682 | 0 |
| Acre-feet of Water | (206,167) | (157,195) | 0 | 0 | 0 | 0 | 0 | (48,972) | 0 | 0 |

**Percent regional change in cluster acreage from $40/acre increase in safflower profit**

| 1,148,378 | Acres | 208,607 | 339,367 | 154,841 | 99,985 | 17,373 | 64,315 | 92,803 | 35,161 | 135,926 |
|---|---|---|---|---|---|---|---|---|---|---|
| 3,255,047 | Ac-ft Water | 423,893 | 929,124 | 483,169 | 328,980 | 141,187 | 156,120 | 246,709 | 117,946 | 427,920 |
| 2.83 | Ac-ft/Acre | | | | | | | | | |
| | **CEN-ALL** | **CEN-C1** | **CEN-C2** | **CEN-C3** | **CEN-C4** | **CEN-C5** | **CEN-C6** | **CEN-C7** | **CEN-C8** | **CEN-C9** |
| Alfalfa | 0.243% | 0.017% | 0.034% | 0.099% | 0.000% | 0.000% | 0.006% | 0.076% | 0.012% | 0.000% |
| Barley | -0.117% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.117% | 0.000% | 0.000% | 0.000% |
| Beans | -0.154% | 0.000% | -0.073% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.081% | 0.000% |
| Broccoli | -0.011% | 0.000% | -0.011% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Corn-Silage | 0.879% | 0.000% | 0.151% | 0.283% | 0.000% | 0.000% | 0.023% | 0.361% | 0.061% | 0.000% |
| Cotton | -21.111% | -6.979% | -4.819% | -4.024% | 0.000% | 0.000% | -2.488% | -2.802% | 0.000% | 0.000% |
| Garlic | 0.009% | 0.009% | 0.000% | 0.000% | 0.000% | 0.000% | 0.001% | 0.000% | 0.000% | 0.000% |
| Lettuce | -0.071% | -0.064% | 0.000% | 0.000% | 0.000% | 0.000% | -0.006% | 0.000% | 0.000% | 0.000% |
| Melons | -0.054% | -0.022% | -0.020% | 0.000% | 0.000% | 0.000% | -0.005% | -0.007% | 0.000% | 0.000% |
| Oats | -1.829% | 0.000% | -1.558% | -0.178% | 0.000% | 0.000% | 0.000% | 0.000% | -0.093% | 0.000% |
| Onions | 0.005% | 0.004% | 0.001% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Rice | 0.378% | 0.000% | 0.378% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sugarbeets | 7.845% | 0.000% | 3.017% | 2.817% | 0.000% | 0.000% | 2.010% | 0.000% | 0.000% | 0.000% |
| Tomatoes | 0.140% | 0.104% | 0.007% | 0.000% | 0.000% | 0.000% | 0.002% | 0.025% | 0.002% | 0.000% |
| Wheat | -0.911% | -0.148% | -0.349% | -0.173% | 0.000% | 0.000% | -0.184% | -0.057% | 0.000% | 0.000% |
| Safflower - external | 14.722% | 7.080% | 3.243% | 1.176% | 0.000% | 0.000% | 0.759% | 2.405% | 0.059% | 0.000% |
| Acre-feet of Water | -6.334% | -4.829% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -1.504% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $40/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added.

## Table E.19 Acreage change in CEN Region from a $20/acre increase in profit from bermudagrass

**Change in acres from $20/acre increase in bermudagrass profit**

| 1,148,372 | Acres | 208,605 | 339,367 | 154,840 | 99,985 | 17,373 | 64,315 | 92,801 | 35,161 | 135,926 |
|---|---|---|---|---|---|---|---|---|---|---|
| | **CEN-ALL** | **CEN-C1** | **CEN-C2** | **CEN-C3** | **CEN-C4** | **CEN-C5** | **CEN-C6** | **CEN-C7** | **CEN-C8** | **CEN-C9** |
| Alfalfa | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Barley | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beans | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Broccoli | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Corn-Silage | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cotton | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Garlic | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lettuce | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Melons | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oats | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Onions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rice | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sugarbeets | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tomatoes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wheat | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bermudagrass - exter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $20/acre increase in bermudagrass profit**

| 1,148,372 | Acres | 208,605 | 339,367 | 154,840 | 99,985 | 17,373 | 64,315 | 92,801 | 35,161 | 135,926 |
|---|---|---|---|---|---|---|---|---|---|---|
| 3,461,214 | Ac-ft Water | 581,088 | 929,124 | 483,169 | 328,980 | 141,187 | 156,120 | 295,681 | 117,946 | 427,920 |
| 3.01 | Ac-ft/Acre | | | | | | | | | |
| | **CEN-ALL** | **CEN-C1** | **CEN-C2** | **CEN-C3** | **CEN-C4** | **CEN-C5** | **CEN-C6** | **CEN-C7** | **CEN-C8** | **CEN-C9** |
| Alfalfa | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Barley | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Broccoli | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Corn-Silage | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Cotton | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Garlic | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Lettuce | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Melons | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Oats | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Onions | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Rice | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sugarbeets | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Wheat | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Bermudagrass - exter | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Acre-feet of Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $20/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added.

## Table E.20 Acreage change in CEN Region from a $40/acre increase in profit from bermudagrass

**Change in acres from $40/acre increase in bermudagrass profit**

| Cluster share of region | | 18.2% | 29.6% | 13.5% | 8.7% | 1.5% | 5.6% | 8.1% | 3.1% | 11.8% |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,148,372 | Acres | 208,605 | 339,367 | 154,840 | 99,985 | 17,373 | 64,315 | 92,801 | 35,161 | 135,926 |
| | **CEN-ALL** | **CEN-C1** | **CEN-C2** | **CEN-C3** | **CEN-C4** | **CEN-C5** | **CEN-C6** | **CEN-C7** | **CEN-C8** | **CEN-C9** |
| Alfalfa | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Barley | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beans | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Broccoli | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Corn-Silage | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cotton | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Garlic | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lettuce | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Melons | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oats | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Onions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rice | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sugarbeets | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tomatoes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wheat | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bermudagrass - exter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $40/acre increase in bermudagrass profit**

| 1,148,372 | Acres | 208,605 | 339,367 | 154,840 | 99,985 | 17,373 | 64,315 | 92,801 | 35,161 | 135,926 |
|---|---|---|---|---|---|---|---|---|---|---|
| 3,461,214 | Ac-ft Water | 581,088 | 929,124 | 483,169 | 328,980 | 141,187 | 156,120 | 295,681 | 117,946 | 427,920 |
| 3.01 | Ac-ft/Acre | | | | | | | | | |
| | **CEN-ALL** | **CEN-C1** | **CEN-C2** | **CEN-C3** | **CEN-C4** | **CEN-C5** | **CEN-C6** | **CEN-C7** | **CEN-C8** | **CEN-C9** |
| Alfalfa | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Barley | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Broccoli | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Corn-Silage | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Cotton | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Garlic | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Lettuce | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Melons | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Oats | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Onions | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Rice | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sugarbeets | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Wheat | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Bermudagrass - exter | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Acre-feet of Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $40/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added.

## Table E.21 Acreage changes in SSJ Region from a $20/acre increase in profit from canola

**Change in acres from $20/acre increase in canola profit**

| 1,193,797 | Acres | 353,223 | 152,759 | 301,912 | 70,920 | 111,495 | 18,440 | 73,322 | 111,727 |
|---|---|---|---|---|---|---|---|---|---|
| | **SSJ-ALL** | **SSJ-C1** | **SSJ-C2** | **SSJ-C3** | **SSJ-C4** | **SSJ-C5** | **SSJ-C6** | **SSJ-C7** | **SSJ-C8** |
| Alfalfa | (3,256) | (1,399) | (803) | (505) | 0 | (518) | 2 | 78 | (110) |
| Barley | (9,716) | (7,494) | 0 | 0 | 0 | 0 | 0 | 0 | (2,222) |
| Beans | (29,830) | (12,422) | (3,315) | (5,767) | (2,195) | (3,745) | 0 | 0 | (2,386) |
| Carrots | (979) | (353) | 0 | (66) | (470) | (96) | 6 | 0 | 0 |
| Corn-Silage | (18,500) | (3,612) | (5,548) | (4,088) | 0 | (2,353) | 0 | (744) | (2,154) |
| Cotton | (59,510) | (18,466) | (2,707) | (27,250) | (937) | (6,635) | (15) | (1,466) | (2,033) |
| Garlic | (38) | 0 | 0 | 0 | (38) | 0 | 0 | 0 | 0 |
| Lettuce | (47) | 0 | 0 | 0 | (47) | 0 | (1) | 0 | 0 |
| Melons | (133) | 0 | 0 | 0 | (88) | 0 | 1 | 0 | (45) |
| Oats | (47,595) | (21,361) | (6,921) | 0 | 0 | 0 | 0 | (1,666) | (17,648) |
| Onions | (208) | (88) | 0 | (60) | (61) | 0 | 0 | 0 | 0 |
| Safflower | (1,334) | 0 | 0 | (895) | 0 | 0 | 0 | 0 | (438) |
| Sugarbeets | (335) | 0 | 0 | (184) | 0 | (83) | 0 | 0 | (67) |
| Potatoes | (155) | 0 | 0 | 0 | (156) | 0 | 1 | 0 | 0 |
| Tomatoes | (639) | (257) | 0 | (298) | (51) | 0 | 1 | 0 | (33) |
| Wheat | (23,797) | (5,216) | (3,417) | (6,213) | 0 | (653) | 0 | (1,331) | (6,966) |
| Canola | 196,116 | 70,676 | 22,716 | 45,333 | 4,046 | 14,089 | 5 | 5,147 | 34,104 |
| Acre-feet of Water | (194,118) | (58,056) | (20,278) | (73,190) | (7,114) | (25,222) | 0 | (3,586) | (6,673) |

**Percent regional change in cluster acreage from $20/acre increase in canola profit**

| 1,193,797 | Acres | 353,223 | 152,759 | 301,912 | 70,920 | 111,495 | 18,440 | 73,322 | 111,727 |
|---|---|---|---|---|---|---|---|---|---|
| 3,730,844 | Ac-ft Water | 1,125,929 | 507,040 | 904,226 | 261,320 | 396,947 | 66,997 | 242,396 | 225,988 |
| 3.13 | Ac-ft/Acre | | | | | | | | |
| | **SSJ-ALL** | **SSJ-C1** | **SSJ-C2** | **SSJ-C3** | **SSJ-C4** | **SSJ-C5** | **SSJ-C6** | **SSJ-C7** | **SSJ-C8** |
| Alfalfa | -0.273% | -0.117% | -0.067% | -0.042% | 0.000% | -0.043% | 0.000% | 0.007% | -0.009% |
| Barley | -0.814% | -0.628% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.186% |
| Beans | -2.499% | -1.041% | -0.278% | -0.483% | -0.184% | -0.314% | 0.000% | 0.000% | -0.200% |
| Carrots | -0.082% | -0.030% | 0.000% | -0.006% | -0.039% | -0.008% | 0.000% | 0.000% | 0.000% |
| Corn-Silage | -1.550% | -0.303% | -0.465% | -0.342% | 0.000% | -0.197% | 0.000% | -0.062% | -0.180% |
| Cotton | -4.985% | -1.547% | -0.227% | -2.283% | -0.078% | -0.556% | -0.001% | -0.123% | -0.170% |
| Garlic | -0.003% | 0.000% | 0.000% | 0.000% | -0.003% | 0.000% | 0.000% | 0.000% | 0.000% |
| Lettuce | -0.004% | 0.000% | 0.000% | 0.000% | -0.004% | 0.000% | 0.000% | 0.000% | 0.000% |
| Melons | -0.011% | 0.000% | 0.000% | 0.000% | -0.007% | 0.000% | 0.000% | 0.000% | -0.004% |
| Oats | -3.987% | -1.789% | -0.580% | 0.000% | 0.000% | 0.000% | 0.000% | -0.140% | -1.478% |
| Onions | -0.017% | -0.007% | 0.000% | -0.005% | -0.005% | 0.000% | 0.000% | 0.000% | 0.000% |
| Safflower | -0.112% | 0.000% | 0.000% | -0.075% | 0.000% | 0.000% | 0.000% | 0.000% | -0.037% |
| Sugarbeets | -0.028% | 0.000% | 0.000% | -0.015% | 0.000% | -0.007% | 0.000% | 0.000% | -0.006% |
| Potatoes | -0.013% | 0.000% | 0.000% | 0.000% | -0.013% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | -0.053% | -0.022% | 0.000% | -0.025% | -0.004% | 0.000% | 0.000% | 0.000% | -0.003% |
| Wheat | -1.993% | -0.437% | -0.286% | -0.520% | 0.000% | -0.055% | 0.000% | -0.112% | -0.584% |
| Canola | 16.428% | 5.920% | 1.903% | 3.797% | 0.339% | 1.180% | 0.000% | 0.431% | 2.857% |
| Acre-feet of Water | -5.203% | -1.556% | -0.544% | -1.962% | -0.191% | -0.676% | 0.000% | -0.096% | -0.179% |

Acres and Ac-feet values presented here represent the values used in the $20/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.

## Table E.22 Acreage change in SSJ Region from a $40/acre increase in profit from canola

**Change in acres from $40/acre increase in canola profit**

| Cluster share of region | | 29.6% | 12.8% | 25.3% | 5.9% | 9.3% | 1.5% | 6.1% | 9.4% |
|---|---|---|---|---|---|---|---|---|---|
| 1,193,797 | Acres | 353,223 | 152,759 | 301,912 | 70,920 | 111,495 | 18,440 | 73,322 | 111,727 |
| | **SSJ-ALL** | **SSJ-C1** | **SSJ-C2** | **SSJ-C3** | **SSJ-C4** | **SSJ-C5** | **SSJ-C6** | **SSJ-C7** | **SSJ-C8** |
| Alfalfa | (9,513) | (3,842) | (2,207) | (1,388) | 0 | (1,424) | 22 | (419) | (255) |
| Barley | (9,716) | (7,494) | 0 | 0 | 0 | 0 | 0 | 0 | (2,222) |
| Beans | (29,830) | (12,422) | (3,315) | (5,767) | (2,195) | (3,745) | 0 | 0 | (2,386) |
| Carrots | (2,479) | (910) | 0 | (170) | (1,209) | (247) | 57 | 0 | 0 |
| Corn-Silage | (47,885) | (8,789) | (13,499) | (9,946) | 0 | (5,726) | 0 | (4,938) | (4,988) |
| Cotton | (149,142) | (44,647) | (6,546) | (65,886) | (2,265) | (16,042) | (157) | (8,889) | (4,709) |
| Garlic | (92) | 0 | 0 | 0 | (94) | 0 | 3 | 0 | 0 |
| Lettuce | (112) | 0 | 0 | 0 | (107) | 0 | (6) | 0 | 0 |
| Melons | (314) | 0 | 0 | 0 | (218) | 0 | 8 | 0 | (104) |
| Oats | (47,595) | (21,361) | (6,921) | 0 | 0 | 0 | 0 | (1,666) | (17,648) |
| Onions | (505) | (213) | 0 | (145) | (149) | 0 | 2 | 0 | 0 |
| Safflower | (2,963) | 0 | 0 | (1,948) | 0 | 0 | 0 | 0 | (1,015) |
| Sugarbeets | (1,020) | 0 | 0 | (596) | 0 | (268) | 0 | 0 | (156) |
| Potatoes | (395) | 0 | 0 | 0 | (409) | 0 | 14 | 0 | 0 |
| Tomatoes | (1,563) | (633) | 0 | (736) | (125) | 0 | 9 | 0 | (77) |
| Wheat | (52,358) | (11,089) | (7,265) | (13,209) | 0 | (1,389) | 0 | (3,275) | (16,132) |
| Canola | 355,529 | 111,408 | 39,757 | 99,797 | 6,775 | 28,846 | 50 | 19,203 | 49,693 |
| Acre-feet of Water | (462,890) | (130,429) | (50,046) | (167,168) | (13,257) | (54,739) | 0 | (28,245) | (19,006) |

**Percent regional change in cluster acreage from $40/acre increase in canola profit**

| 1,193,797 | Acres | 353,223 | 152,759 | 301,912 | 70,920 | 111,495 | 18,440 | 73,322 | 111,727 |
|---|---|---|---|---|---|---|---|---|---|
| 3,462,072 | Ac-ft Water | 1,053,555 | 477,272 | 810,249 | 255,176 | 367,430 | 66,997 | 217,737 | 213,655 |
| 2.90 | Ac-ft/Acre | | | | | | | | |
| | **SSJ-ALL** | **SSJ-C1** | **SSJ-C2** | **SSJ-C3** | **SSJ-C4** | **SSJ-C5** | **SSJ-C6** | **SSJ-C7** | **SSJ-C8** |
| Alfalfa | -0.797% | -0.322% | -0.185% | -0.116% | 0.000% | -0.119% | 0.002% | -0.035% | -0.021% |
| Barley | -0.814% | -0.628% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.186% |
| Beans | -2.499% | -1.041% | -0.278% | -0.483% | -0.184% | -0.314% | 0.000% | 0.000% | -0.200% |
| Carrots | -0.208% | -0.076% | 0.000% | -0.014% | -0.101% | -0.021% | 0.005% | 0.000% | 0.000% |
| Corn-Silage | -4.011% | -0.736% | -1.131% | -0.833% | 0.000% | -0.480% | 0.000% | -0.414% | -0.418% |
| Cotton | -12.493% | -3.740% | -0.548% | -5.519% | -0.190% | -1.344% | -0.013% | -0.745% | -0.394% |
| Garlic | -0.008% | 0.000% | 0.000% | 0.000% | -0.008% | 0.000% | 0.000% | 0.000% | 0.000% |
| Lettuce | -0.009% | 0.000% | 0.000% | 0.000% | -0.009% | 0.000% | 0.000% | 0.000% | 0.000% |
| Melons | -0.026% | 0.000% | 0.000% | 0.000% | -0.018% | 0.000% | 0.001% | 0.000% | -0.009% |
| Oats | -3.987% | -1.789% | -0.580% | 0.000% | 0.000% | 0.000% | 0.000% | -0.140% | -1.478% |
| Onions | -0.042% | -0.018% | 0.000% | -0.012% | -0.012% | 0.000% | 0.000% | 0.000% | 0.000% |
| Safflower | -0.248% | 0.000% | 0.000% | -0.163% | 0.000% | 0.000% | 0.000% | 0.000% | -0.085% |
| Sugarbeets | -0.085% | 0.000% | 0.000% | -0.050% | 0.000% | -0.022% | 0.000% | 0.000% | -0.013% |
| Potatoes | -0.033% | 0.000% | 0.000% | 0.000% | -0.034% | 0.000% | 0.001% | 0.000% | 0.000% |
| Tomatoes | -0.131% | -0.053% | 0.000% | -0.062% | -0.010% | 0.000% | 0.001% | 0.000% | -0.006% |
| Wheat | -4.386% | -0.929% | -0.609% | -1.106% | 0.000% | -0.116% | 0.000% | -0.274% | -1.351% |
| Canola | 29.781% | 9.332% | 3.330% | 8.360% | 0.567% | 2.416% | 0.004% | 1.609% | 4.163% |
| Acre-feet of Water | -13.370% | -3.767% | -1.446% | -4.829% | -0.383% | -1.581% | 0.000% | -0.816% | -0.549% |

Acres and Ac-feet values presented here represent the values used in the $40/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.

## Table E.23 Acreage change in SSJ Region from a $20/acre increase in profit from sweet sorghum

**Change in acres from $20/acre increase in sweet sorghum profit**

| 1,152,749 | Acres | 336,962 | 148,638 | 298,916 | 70,554 | 110,753 | 18,440 | 72,047 | 96,440 |
|---|---|---|---|---|---|---|---|---|---|
| | **SSJ-ALL** | **SSJ-C1** | **SSJ-C2** | **SSJ-C3** | **SSJ-C4** | **SSJ-C5** | **SSJ-C6** | **SSJ-C7** | **SSJ-C8** |
| Alfalfa | (5,399) | (2,232) | (1,282) | (806) | 0 | (827) | 0 | (92) | (160) |
| Barley | (6,917) | (4,695) | 0 | 0 | 0 | 0 | 0 | 0 | (2,222) |
| Beans | (29,830) | (12,422) | (3,315) | (5,767) | (2,195) | (3,745) | 0 | 0 | (2,386) |
| Carrots | (1,215) | (436) | 0 | (81) | (579) | (118) | 0 | 0 | 0 |
| Corn-Silage | (17,151) | (3,375) | (5,183) | (3,819) | 0 | (2,199) | 0 | (552) | (2,024) |
| Cotton | (53,315) | (16,658) | (2,442) | (24,582) | (845) | (5,985) | 0 | (953) | (1,849) |
| Garlic | (38) | 0 | 0 | 0 | (38) | 0 | 0 | 0 | 0 |
| Lettuce | (29) | 0 | 0 | 0 | (29) | 0 | 0 | 0 | 0 |
| Melons | (134) | 0 | 0 | 0 | (89) | 0 | 0 | 0 | (45) |
| Oats | (37,031) | (13,382) | (4,336) | 0 | 0 | 0 | 0 | (1,666) | (17,648) |
| Onions | (195) | (82) | 0 | (56) | (57) | 0 | 0 | 0 | 0 |
| Safflower | (490) | 0 | 0 | (350) | 0 | 0 | 0 | 0 | (140) |
| Sugarbeets | (833) | 0 | 0 | (484) | 0 | (218) | 0 | 0 | (132) |
| Potatoes | (208) | 0 | 0 | 0 | (208) | 0 | 0 | 0 | 0 |
| Tomatoes | (642) | (258) | 0 | (300) | (51) | 0 | 0 | 0 | (34) |
| Wheat | (5,700) | (1,495) | (979) | (1,780) | 0 | (187) | 0 | (100) | (1,158) |
| Sweet Sorghum | 118,126 | 38,781 | 13,421 | 35,037 | 3,729 | 12,542 | 0 | 2,106 | 12,511 |
| Total Acres | (41,003) | (16,252) | (4,117) | (2,989) | (363) | (737) | 0 | (1,257) | (15,287) |

**Percent regional change in cluster acreage from $20/acre increase in sweet sorghum profit**

| 1,152,749 | Acres | 336,962 | 148,638 | 298,916 | 70,554 | 110,753 | 18,440 | 72,047 | 96,440 |
|---|---|---|---|---|---|---|---|---|---|
| 3,924,962 | Ac-ft Water | 1,183,984 | 527,318 | 977,417 | 268,434 | 422,169 | 66,997 | 245,982 | 232,661 |
| 3.40 | Ac-ft/Acre | | | | | | | | |
| | **SSJ-ALL** | **SSJ-C1** | **SSJ-C2** | **SSJ-C3** | **SSJ-C4** | **SSJ-C5** | **SSJ-C6** | **SSJ-C7** | **SSJ-C8** |
| Alfalfa | -0.468% | -0.194% | -0.111% | -0.070% | 0.000% | -0.072% | 0.000% | -0.008% | -0.014% |
| Barley | -0.600% | -0.407% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.193% |
| Beans | -2.588% | -1.078% | -0.288% | -0.500% | -0.190% | -0.325% | 0.000% | 0.000% | -0.207% |
| Carrots | -0.105% | -0.038% | 0.000% | -0.007% | -0.050% | -0.010% | 0.000% | 0.000% | 0.000% |
| Corn-Silage | -1.488% | -0.293% | -0.450% | -0.331% | 0.000% | -0.191% | 0.000% | -0.048% | -0.176% |
| Cotton | -4.625% | -1.445% | -0.212% | -2.132% | -0.073% | -0.519% | 0.000% | -0.083% | -0.160% |
| Garlic | -0.003% | 0.000% | 0.000% | 0.000% | -0.003% | 0.000% | 0.000% | 0.000% | 0.000% |
| Lettuce | -0.003% | 0.000% | 0.000% | 0.000% | -0.003% | 0.000% | 0.000% | 0.000% | 0.000% |
| Melons | -0.012% | 0.000% | 0.000% | 0.000% | -0.008% | 0.000% | 0.000% | 0.000% | -0.004% |
| Oats | -3.212% | -1.161% | -0.376% | 0.000% | 0.000% | 0.000% | 0.000% | -0.145% | -1.531% |
| Onions | -0.017% | -0.007% | 0.000% | -0.005% | -0.005% | 0.000% | 0.000% | 0.000% | 0.000% |
| Safflower | -0.043% | 0.000% | 0.000% | -0.030% | 0.000% | 0.000% | 0.000% | 0.000% | -0.012% |
| Sugarbeets | -0.072% | 0.000% | 0.000% | -0.042% | 0.000% | -0.019% | 0.000% | 0.000% | -0.011% |
| Potatoes | -0.018% | 0.000% | 0.000% | 0.000% | -0.018% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | -0.056% | -0.022% | 0.000% | -0.026% | -0.004% | 0.000% | 0.000% | 0.000% | -0.003% |
| Wheat | -0.494% | -0.130% | -0.085% | -0.154% | 0.000% | -0.016% | 0.000% | -0.009% | -0.100% |
| Sweet Sorghum | 10.247% | 3.364% | 1.164% | 3.039% | 0.324% | 1.088% | 0.000% | 0.183% | 1.085% |
| Total Acres | -3.557% | -1.410% | -0.357% | -0.259% | -0.032% | -0.064% | 0.000% | -0.109% | -1.326% |

Acres and Ac-feet values presented here represent the values used in the $20/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.

## Table E.24 Acreage change in SSJ Region from a $40/acre increase in profit from sweet sorghum

**Change in acres from $40/acre increase in sweet sorghum profit**

| Cluster share of region | | 29.2% | 12.9% | 25.9% | 6.1% | 9.6% | 1.6% | 6.3% | 8.4% |
|---|---|---|---|---|---|---|---|---|---|
| 1,152,749 | Acres | 336,962 | 148,638 | 298,916 | 70,554 | 110,753 | 18,440 | 72,047 | 96,440 |
| | **SSJ-ALL** | **SSJ-C1** | **SSJ-C2** | **SSJ-C3** | **SSJ-C4** | **SSJ-C5** | **SSJ-C6** | **SSJ-C7** | **SSJ-C8** |
| Alfalfa | (14,284) | (5,691) | (3,269) | (2,056) | 0 | (2,109) | 0 | (795) | (365) |
| Barley | (9,716) | (7,494) | 0 | 0 | 0 | 0 | 0 | 0 | (2,222) |
| Beans | (29,830) | (12,422) | (3,315) | (5,767) | (2,195) | (3,745) | 0 | 0 | (2,386) |
| Carrots | (3,096) | (1,111) | 0 | (207) | (1,477) | (301) | 0 | 0 | 0 |
| Corn-Silage | (46,831) | (8,603) | (13,214) | (9,736) | 0 | (5,605) | 0 | (4,787) | (4,887) |
| Cotton | (141,530) | (42,466) | (6,226) | (62,668) | (2,155) | (15,258) | 0 | (8,271) | (4,486) |
| Garlic | (98) | 0 | 0 | 0 | (98) | 0 | 0 | 0 | 0 |
| Lettuce | (75) | 0 | 0 | 0 | (75) | 0 | 0 | 0 | 0 |
| Melons | (334) | 0 | 0 | 0 | (226) | 0 | 0 | 0 | (108) |
| Oats | (47,595) | (21,361) | (6,921) | 0 | 0 | 0 | 0 | (1,666) | (17,648) |
| Onions | (496) | (208) | 0 | (142) | (146) | 0 | 0 | 0 | 0 |
| Safflower | (1,330) | 0 | 0 | (893) | 0 | 0 | 0 | 0 | (437) |
| Sugarbeets | (2,081) | 0 | 0 | (1,234) | 0 | (555) | 0 | 0 | (293) |
| Potatoes | (530) | 0 | 0 | 0 | (530) | 0 | 0 | 0 | 0 |
| Tomatoes | (1,633) | (658) | 0 | (764) | (130) | 0 | 0 | 0 | (80) |
| Wheat | (16,961) | (3,810) | (2,496) | (4,539) | 0 | (477) | 0 | (866) | (4,773) |
| Sweet Sorghum | 258,798 | 78,704 | 28,969 | 82,312 | 6,839 | 27,423 | 0 | 14,506 | 20,045 |
| Total Acres | (57,623) | (25,120) | (6,471) | (5,694) | (193) | (628) | 0 | (1,878) | (17,640) |

**Percent regional change in cluster acreage from $40/acre increase in sweet sorghum profit**

| 1,152,749 | Acres | 336,962 | 148,638 | 298,916 | 70,554 | 110,753 | 18,440 | 72,047 | 96,440 |
|---|---|---|---|---|---|---|---|---|---|
| 3,924,962 | Ac-ft Water | 1,183,984 | 527,318 | 977,417 | 268,434 | 422,169 | 66,997 | 245,982 | 232,661 |
| 3.40 | Ac-ft/Acre | | | | | | | | |
| | **SSJ-ALL** | **SSJ-C1** | **SSJ-C2** | **SSJ-C3** | **SSJ-C4** | **SSJ-C5** | **SSJ-C6** | **SSJ-C7** | **SSJ-C8** |
| Alfalfa | -1.239% | -0.494% | -0.284% | -0.178% | 0.000% | -0.183% | 0.000% | -0.069% | -0.032% |
| Barley | -0.843% | -0.650% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.193% |
| Beans | -2.588% | -1.078% | -0.288% | -0.500% | -0.190% | -0.325% | 0.000% | 0.000% | -0.207% |
| Carrots | -0.269% | -0.096% | 0.000% | -0.018% | -0.128% | -0.026% | 0.000% | 0.000% | 0.000% |
| Corn-Silage | -4.063% | -0.746% | -1.146% | -0.845% | 0.000% | -0.486% | 0.000% | -0.415% | -0.424% |
| Cotton | -12.278% | -3.684% | -0.540% | -5.436% | -0.187% | -1.324% | 0.000% | -0.717% | -0.389% |
| Garlic | -0.008% | 0.000% | 0.000% | 0.000% | -0.008% | 0.000% | 0.000% | 0.000% | 0.000% |
| Lettuce | -0.007% | 0.000% | 0.000% | 0.000% | -0.007% | 0.000% | 0.000% | 0.000% | 0.000% |
| Melons | -0.029% | 0.000% | 0.000% | 0.000% | -0.020% | 0.000% | 0.000% | 0.000% | -0.009% |
| Oats | -4.129% | -1.853% | -0.600% | 0.000% | 0.000% | 0.000% | 0.000% | -0.145% | -1.531% |
| Onions | -0.043% | -0.018% | 0.000% | -0.012% | -0.013% | 0.000% | 0.000% | 0.000% | 0.000% |
| Safflower | -0.115% | 0.000% | 0.000% | -0.077% | 0.000% | 0.000% | 0.000% | 0.000% | -0.038% |
| Sugarbeets | -0.181% | 0.000% | 0.000% | -0.107% | 0.000% | -0.048% | 0.000% | 0.000% | -0.025% |
| Potatoes | -0.046% | 0.000% | 0.000% | 0.000% | -0.046% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | -0.142% | -0.057% | 0.000% | -0.066% | -0.011% | 0.000% | 0.000% | 0.000% | -0.007% |
| Wheat | -1.471% | -0.331% | -0.217% | -0.394% | 0.000% | -0.041% | 0.000% | -0.075% | -0.414% |
| Sweet Sorghum | 22.451% | 6.827% | 2.513% | 7.140% | 0.593% | 2.379% | 0.000% | 1.258% | 1.739% |
| Total Acres | -4.999% | -2.179% | -0.561% | -0.494% | -0.017% | -0.054% | 0.000% | -0.163% | -1.530% |

Acres and Ac-feet values presented here represent the values used in the $40/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.

## Table E.25 Acreage change in SSJ Region from a $20/acre increase in profit from sugarbeets

**Change in acres from $20/acre increase in sugarbeet profit**

| 1,169,899 | Acres | 336,448 | 147,861 | 301,431 | 69,411 | 111,277 | 18,440 | 73,304 | 111,727 |
|---|---|---|---|---|---|---|---|---|---|
| | **SSJ-ALL** | **SSJ-C1** | **SSJ-C2** | **SSJ-C3** | **SSJ-C4** | **SSJ-C5** | **SSJ-C6** | **SSJ-C7** | **SSJ-C8** |
| Alfalfa | (1,326) | (842) | (484) | 0 | 0 | 0 | 0 | 0 | 0 |
| Barley | (1,771) | (1,771) | 0 | 0 | 0 | 0 | 0 | 0 | (0) |
| Beans | (19,324) | (12,422) | (3,315) | (802) | (2,195) | (360) | 0 | 0 | (229) |
| Carrots | (383) | (164) | 0 | 0 | (218) | 0 | 0 | 0 | 0 |
| Corn-Silage | (3,228) | (1,273) | (1,955) | 0 | 0 | 0 | 0 | 0 | 0 |
| Cotton | (7,523) | (6,283) | (921) | 0 | (319) | 0 | 0 | 0 | 0 |
| Garlic | (14) | 0 | 0 | 0 | (14) | 0 | 0 | 0 | 0 |
| Lettuce | (11) | 0 | 0 | 0 | (11) | 0 | 0 | 0 | 0 |
| Melons | (33) | 0 | 0 | 0 | (33) | 0 | 0 | 0 | 0 |
| Oats | (6,530) | (5,047) | (1,635) | 0 | 0 | 0 | 0 | 0 | 153 |
| Onions | (52) | (31) | 0 | 0 | (22) | 0 | 0 | 0 | 0 |
| Safflower | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sugarbeets-internal | 593 | 0 | 0 | 356 | 0 | 160 | 0 | 0 | 76 |
| Potatoes | (78) | 0 | 0 | 0 | (78) | 0 | 0 | 0 | 0 |
| Tomatoes | (117) | (97) | 0 | 0 | (19) | 0 | 0 | 0 | 0 |
| Wheat | (933) | (564) | (369) | 0 | 0 | 0 | 0 | 0 | 0 |
| Sugarbeets-external | 16,918 | 11,727 | 3,786 | 0 | 1,405 | 0 | 0 | 0 | 0 |
| Total Acres | (23,812) | (16,766) | (4,893) | (445) | (1,506) | (200) | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $20/acre increase in sugarbeet profit**

| 1,169,899 | Acres | 336,448 | 147,861 | 301,431 | 69,411 | 111,277 | 18,440 | 73,304 | 111,727 |
|---|---|---|---|---|---|---|---|---|---|
| 3,924,962 | Ac-ft Water | 1,183,984 | 527,318 | 977,417 | 268,434 | 422,169 | 66,997 | 245,982 | 232,661 |
| 3.35 | Ac-ft/Acre | | | | | | | | |
| | **SSJ-ALL** | **SSJ-C1** | **SSJ-C2** | **SSJ-C3** | **SSJ-C4** | **SSJ-C5** | **SSJ-C6** | **SSJ-C7** | **SSJ-C8** |
| Alfalfa | -0.113% | -0.072% | -0.041% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Barley | -0.151% | -0.151% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -1.652% | -1.062% | -0.283% | -0.069% | -0.188% | -0.031% | 0.000% | 0.000% | -0.020% |
| Carrots | -0.033% | -0.014% | 0.000% | 0.000% | -0.019% | 0.000% | 0.000% | 0.000% | 0.000% |
| Corn-Silage | -0.276% | -0.109% | -0.167% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Cotton | -0.643% | -0.537% | -0.079% | 0.000% | -0.027% | 0.000% | 0.000% | 0.000% | 0.000% |
| Garlic | -0.001% | 0.000% | 0.000% | 0.000% | -0.001% | 0.000% | 0.000% | 0.000% | 0.000% |
| Lettuce | -0.001% | 0.000% | 0.000% | 0.000% | -0.001% | 0.000% | 0.000% | 0.000% | 0.000% |
| Melons | -0.003% | 0.000% | 0.000% | 0.000% | -0.003% | 0.000% | 0.000% | 0.000% | 0.000% |
| Oats | -0.558% | -0.431% | -0.140% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.013% |
| Onions | -0.004% | -0.003% | 0.000% | 0.000% | -0.002% | 0.000% | 0.000% | 0.000% | 0.000% |
| Safflower | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sugarbeets-internal | 0.051% | 0.000% | 0.000% | 0.030% | 0.000% | 0.014% | 0.000% | 0.000% | 0.007% |
| Potatoes | -0.007% | 0.000% | 0.000% | 0.000% | -0.007% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | -0.010% | -0.008% | 0.000% | 0.000% | -0.002% | 0.000% | 0.000% | 0.000% | 0.000% |
| Wheat | -0.080% | -0.048% | -0.032% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sugarbeets-external | 1.446% | 1.002% | 0.324% | 0.000% | 0.120% | 0.000% | 0.000% | 0.000% | 0.000% |
| Total Acres | -2.035% | -1.433% | -0.418% | -0.038% | -0.129% | -0.017% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $20/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added

## Table E.26 Acreage change in SSJ Region from a $40/acre increase in profit from sugarbeets

**Change in acres from $40/acre increase in sugarbeet profit**

| Cluster share of region | | 27.6% | 12.4% | 26.5% | 6.1% | 9.8% | 1.6% | 6.2% | 9.8% |
|---|---|---|---|---|---|---|---|---|---|
| 1,134,683 | Acres | 313,066 | 140,629 | 300,945 | 68,732 | 111,058 | 18,440 | 70,086 | 111,727 |
| | **SSJ-ALL** | **SSJ-C1** | **SSJ-C2** | **SSJ-C3** | **SSJ-C4** | **SSJ-C5** | **SSJ-C6** | **SSJ-C7** | **SSJ-C8** |
| Alfalfa | (4,682) | (2,837) | (1,630) | 0 | 0 | 0 | 0 | (215) | 0 |
| Barley | (5,967) | (5,967) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beans | (20,842) | (12,422) | (3,315) | (1,676) | (2,195) | (754) | 0 | 0 | (480) |
| Carrots | (1,290) | (554) | 0 | 0 | (736) | 0 | 0 | 0 | 0 |
| Corn-Silage | (12,171) | (4,289) | (6,588) | 0 | 0 | 0 | 0 | (1,293) | 0 |
| Cotton | (27,586) | (21,173) | (3,104) | 0 | (1,074) | 0 | 0 | (2,234) | 0 |
| Garlic | (49) | 0 | 0 | 0 | (49) | 0 | 0 | 0 | 0 |
| Lettuce | (37) | 0 | 0 | 0 | (37) | 0 | 0 | 0 | 0 |
| Melons | (113) | 0 | 0 | 0 | (113) | 0 | 0 | 0 | 0 |
| Oats | (23,866) | (17,009) | (5,511) | 0 | 0 | 0 | 0 | (1,666) | 320 |
| Onions | (177) | (104) | 0 | 0 | (73) | 0 | 0 | 0 | 0 |
| Safflower | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sugarbeets-internal | 1,240 | 0 | 0 | 745 | 0 | 335 | 0 | 0 | 160 |
| Potatoes | (264) | 0 | 0 | 0 | (264) | 0 | 0 | 0 | 0 |
| Tomatoes | (393) | (328) | 0 | 0 | (65) | 0 | 0 | 0 | 0 |
| Wheat | (3,378) | (1,900) | (1,245) | 0 | 0 | 0 | 0 | (234) | 0 |
| Sugarbeets-external | 40,548 | 26,437 | 9,267 | 0 | 2,422 | 0 | 0 | 2,423 | 0 |
| Total Acres | (59,027) | (40,148) | (12,126) | (931) | (2,185) | (419) | 0 | (3,218) | 0 |

**Percent regional change in cluster acreage from $40/acre increase in sugarbeet profit**

| 1,134,683 | Acres | 313,066 | 140,629 | 300,945 | 68,732 | 111,058 | 18,440 | 70,086 | 111,727 |
|---|---|---|---|---|---|---|---|---|---|
| 3,924,962 | Ac-ft Water | 1,183,984 | 527,318 | 977,417 | 268,434 | 422,169 | 66,997 | 245,982 | 232,661 |
| 3.46 | Ac-ft/Acre | | | | | | | | |
| | **SSJ-ALL** | **SSJ-C1** | **SSJ-C2** | **SSJ-C3** | **SSJ-C4** | **SSJ-C5** | **SSJ-C6** | **SSJ-C7** | **SSJ-C8** |
| Alfalfa | -0.413% | -0.250% | -0.144% | 0.000% | 0.000% | 0.000% | 0.000% | -0.019% | 0.000% |
| Barley | -0.526% | -0.526% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -1.837% | -1.095% | -0.292% | -0.148% | -0.193% | -0.066% | 0.000% | 0.000% | -0.042% |
| Carrots | -0.114% | -0.049% | 0.000% | 0.000% | -0.065% | 0.000% | 0.000% | 0.000% | 0.000% |
| Corn-Silage | -1.073% | -0.378% | -0.581% | 0.000% | 0.000% | 0.000% | 0.000% | -0.114% | 0.000% |
| Cotton | -2.431% | -1.866% | -0.274% | 0.000% | -0.095% | 0.000% | 0.000% | -0.197% | 0.000% |
| Garlic | -0.004% | 0.000% | 0.000% | 0.000% | -0.004% | 0.000% | 0.000% | 0.000% | 0.000% |
| Lettuce | -0.003% | 0.000% | 0.000% | 0.000% | -0.003% | 0.000% | 0.000% | 0.000% | 0.000% |
| Melons | -0.010% | 0.000% | 0.000% | 0.000% | -0.010% | 0.000% | 0.000% | 0.000% | 0.000% |
| Oats | -2.103% | -1.499% | -0.486% | 0.000% | 0.000% | 0.000% | 0.000% | -0.147% | 0.028% |
| Onions | -0.016% | -0.009% | 0.000% | 0.000% | -0.006% | 0.000% | 0.000% | 0.000% | 0.000% |
| Safflower | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sugarbeets-internal | 0.109% | 0.000% | 0.000% | 0.066% | 0.000% | 0.030% | 0.000% | 0.000% | 0.014% |
| Potatoes | -0.023% | 0.000% | 0.000% | 0.000% | -0.023% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | -0.035% | -0.029% | 0.000% | 0.000% | -0.006% | 0.000% | 0.000% | 0.000% | 0.000% |
| Wheat | -0.298% | -0.167% | -0.110% | 0.000% | 0.000% | 0.000% | 0.000% | -0.021% | 0.000% |
| Sugarbeets-external | 3.574% | 2.330% | 0.817% | 0.000% | 0.213% | 0.000% | 0.000% | 0.214% | 0.000% |
| Total Acres | -5.202% | -3.538% | -1.069% | -0.082% | -0.193% | -0.037% | 0.000% | -0.284% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $40/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added

## Table E.27 Acreage change in SSJ Region from a $20/acre increase in profit from safflower

**Change in acres from $20/acre increase in safflower profit**

| 1,193,797 | Acres | 353,223 | 152,759 | 301,912 | 70,920 | 111,495 | 18,440 | 73,322 | 111,727 |
|---|---|---|---|---|---|---|---|---|---|
| | **SSJ-ALL** | **SSJ-C1** | **SSJ-C2** | **SSJ-C3** | **SSJ-C4** | **SSJ-C5** | **SSJ-C6** | **SSJ-C7** | **SSJ-C8** |
| Alfalfa | (3,111) | (1,636) | (940) | 41 | 0 | (606) | 0 | 30 | 0 |
| Barley | (7,494) | (7,494) | 0 | 0 | 0 | 0 | 0 | 0 | (0) |
| Beans | (23,278) | (12,422) | (3,315) | (1,384) | (2,195) | (3,745) | 0 | 0 | (217) |
| Carrots | (1,056) | (407) | 0 | 3 | (541) | (111) | 0 | 0 | 0 |
| Corn-Silage | (14,175) | (4,114) | (6,319) | 90 | 0 | (2,681) | 0 | (1,151) | (0) |
| Cotton | (34,362) | (21,005) | (3,080) | 522 | (1,066) | (7,547) | 0 | (2,186) | 0 |
| Garlic | (44) | 0 | 0 | 0 | (44) | 0 | 0 | 0 | 0 |
| Lettuce | (52) | 0 | 0 | 0 | (52) | 0 | 0 | 0 | 0 |
| Melons | (101) | 0 | 0 | 0 | (101) | 0 | 0 | 0 | 0 |
| Oats | (30,246) | (21,361) | (6,921) | 0 | 0 | 0 | 0 | (1,666) | (299) |
| Onions | (168) | (100) | 0 | 1 | (70) | 0 | 0 | 0 | 0 |
| Safflower-internal | 1,430 | 0 | 0 | 914 | 0 | 0 | 0 | 0 | 516 |
| Sugarbeets | (69) | 0 | 0 | 32 | 0 | (101) | 0 | 0 | 0 |
| Potatoes | (180) | 0 | 0 | 0 | (180) | 0 | 0 | 0 | 0 |
| Tomatoes | (343) | (293) | 0 | 8 | (58) | 0 | 0 | 0 | 0 |
| Wheat | (12,042) | (5,786) | (3,790) | (221) | 0 | (724) | 0 | (1,520) | 0 |
| Safflower-external | 125,337 | 74,627 | 24,369 | 0 | 4,311 | 15,520 | 0 | 6,510 | 0 |
| Acre-feet of Water | (81,159) | (35,225) | (14,698) | 0 | (5,986) | (21,877) | 0 | (3,373) | 0 |

**Percent regional change in cluster acreage from $20/acre increase in safflower profit**

| 1,193,797 | Acres | 353,223 | 152,759 | 301,912 | 70,920 | 111,495 | 18,440 | 73,322 | 111,727 |
|---|---|---|---|---|---|---|---|---|---|
| 3,843,803 | Ac-ft Water | 1,148,759 | 512,620 | 977,417 | 262,448 | 400,292 | 66,997 | 242,608 | 232,661 |
| 3.22 | Ac-ft/Acre | | | | | | | | |
| | **SSJ-ALL** | **SSJ-C1** | **SSJ-C2** | **SSJ-C3** | **SSJ-C4** | **SSJ-C5** | **SSJ-C6** | **SSJ-C7** | **SSJ-C8** |
| Alfalfa | -0.261% | -0.137% | -0.079% | 0.003% | 0.000% | -0.051% | 0.000% | 0.002% | 0.000% |
| Barley | -0.628% | -0.628% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -1.950% | -1.041% | -0.278% | -0.116% | -0.184% | -0.314% | 0.000% | 0.000% | -0.018% |
| Carrots | -0.088% | -0.034% | 0.000% | 0.000% | -0.045% | -0.009% | 0.000% | 0.000% | 0.000% |
| Corn-Silage | -1.187% | -0.345% | -0.529% | 0.008% | 0.000% | -0.225% | 0.000% | -0.096% | 0.000% |
| Cotton | -2.878% | -1.760% | -0.258% | 0.044% | -0.089% | -0.632% | 0.000% | -0.183% | 0.000% |
| Garlic | -0.004% | 0.000% | 0.000% | 0.000% | -0.004% | 0.000% | 0.000% | 0.000% | 0.000% |
| Lettuce | -0.004% | 0.000% | 0.000% | 0.000% | -0.004% | 0.000% | 0.000% | 0.000% | 0.000% |
| Melons | -0.008% | 0.000% | 0.000% | 0.000% | -0.008% | 0.000% | 0.000% | 0.000% | 0.000% |
| Oats | -2.534% | -1.789% | -0.580% | 0.000% | 0.000% | 0.000% | 0.000% | -0.140% | -0.025% |
| Onions | -0.014% | -0.008% | 0.000% | 0.000% | -0.006% | 0.000% | 0.000% | 0.000% | 0.000% |
| Safflower-internal | 0.120% | 0.000% | 0.000% | 0.077% | 0.000% | 0.000% | 0.000% | 0.000% | 0.043% |
| Sugarbeets | -0.006% | 0.000% | 0.000% | 0.003% | 0.000% | -0.008% | 0.000% | 0.000% | 0.000% |
| Potatoes | -0.015% | 0.000% | 0.000% | 0.000% | -0.015% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | -0.029% | -0.025% | 0.000% | 0.001% | -0.005% | 0.000% | 0.000% | 0.000% | 0.000% |
| Wheat | -1.009% | -0.485% | -0.318% | -0.019% | 0.000% | -0.061% | 0.000% | -0.127% | 0.000% |
| Safflower-external | 10.499% | 6.251% | 2.041% | 0.000% | 0.361% | 1.300% | 0.000% | 0.545% | 0.000% |
| Acre-feet of Water | -2.111% | -0.916% | -0.382% | 0.000% | -0.156% | -0.569% | 0.000% | -0.088% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $20/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added

## Table E.28 Acreage change in SSJ Region from a $40/acre increase in profit from safflower

**Change in acres from $40/acre increase in safflower profit**

| Cluster share of region | | 29.6% | 12.8% | 25.3% | 5.9% | 9.3% | 1.5% | 6.1% | 9.4% |
|---|---|---|---|---|---|---|---|---|---|
| 1,193,797 | Acres | 353,223 | 152,759 | 301,912 | 70,920 | 111,495 | 18,440 | 73,322 | 111,727 |
| | **SSJ-ALL** | **SSJ-C1** | **SSJ-C2** | **SSJ-C3** | **SSJ-C4** | **SSJ-C5** | **SSJ-C6** | **SSJ-C7** | **SSJ-C8** |
| Alfalfa | (8,092) | (3,982) | (2,287) | 77 | 0 | (1,476) | 22 | (447) | 0 |
| Barley | (7,494) | (7,494) | 0 | 0 | 0 | 0 | 0 | 0 | (0) |
| Beans | (24,674) | (12,422) | (3,315) | (2,593) | (2,195) | (3,745) | 0 | 0 | (403) |
| Carrots | (2,385) | (941) | 0 | 6 | (1,252) | (255) | 57 | 0 | 0 |
| Corn-Silage | (33,961) | (9,084) | (13,952) | 169 | 0 | (5,918) | 0 | (5,177) | (0) |
| Cotton | (80,325) | (46,139) | (6,765) | 982 | (2,341) | (16,578) | (171) | (9,312) | 0 |
| Garlic | (95) | 0 | 0 | 0 | (97) | 0 | 3 | 0 | 0 |
| Lettuce | (116) | 0 | 0 | 0 | (110) | 0 | (6) | 0 | 0 |
| Melons | (217) | 0 | 0 | 0 | (225) | 0 | 8 | 0 | 0 |
| Oats | (30,504) | (21,361) | (6,921) | 0 | 0 | 0 | 0 | (1,666) | (557) |
| Onions | (370) | (220) | 0 | 2 | (154) | 0 | 2 | 0 | 0 |
| Safflower-internal | 2,665 | 0 | 0 | 1,704 | 0 | 0 | 0 | 0 | 960 |
| Sugarbeets | (219) | 0 | 0 | 60 | 0 | (279) | 0 | 0 | 0 |
| Potatoes | (409) | 0 | 0 | 0 | (423) | 0 | 14 | 0 | 0 |
| Tomatoes | (760) | (655) | 0 | 16 | (129) | 0 | 9 | 0 | 0 |
| Wheat | (24,140) | (11,424) | (7,484) | (416) | 0 | (1,430) | 0 | (3,385) | 0 |
| Safflower-external | 211,142 | 113,730 | 40,728 | 0 | 6,930 | 29,687 | 63 | 20,005 | 0 |
| Acre-feet of Water | (201,464) | (89,062) | (35,371) | 0 | (10,835) | (44,547) | 0 | (21,649) | 0 |

**Percent regional change in cluster acreage from $40/acre increase in safflower profit**

| 1,193,797 | Acres | 353,223 | 152,759 | 301,912 | 70,920 | 111,495 | 18,440 | 73,322 | 111,727 |
|---|---|---|---|---|---|---|---|---|---|
| 3,723,498 | Ac-ft Water | 1,094,922 | 491,948 | 977,417 | 257,598 | 377,622 | 66,997 | 224,333 | 232,661 |
| 3.12 | Ac-ft/Acre | | | | | | | | |
| | **SSJ-ALL** | **SSJ-C1** | **SSJ-C2** | **SSJ-C3** | **SSJ-C4** | **SSJ-C5** | **SSJ-C6** | **SSJ-C7** | **SSJ-C8** |
| Alfalfa | -0.678% | -0.334% | -0.192% | 0.006% | 0.000% | -0.124% | 0.002% | -0.037% | 0.000% |
| Barley | -0.628% | -0.628% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -2.067% | -1.041% | -0.278% | -0.217% | -0.184% | -0.314% | 0.000% | 0.000% | -0.034% |
| Carrots | -0.200% | -0.079% | 0.000% | 0.001% | -0.105% | -0.021% | 0.005% | 0.000% | 0.000% |
| Corn-Silage | -2.845% | -0.761% | -1.169% | 0.014% | 0.000% | -0.496% | 0.000% | -0.434% | 0.000% |
| Cotton | -6.729% | -3.865% | -0.567% | 0.082% | -0.196% | -1.389% | -0.014% | -0.780% | 0.000% |
| Garlic | -0.008% | 0.000% | 0.000% | 0.000% | -0.008% | 0.000% | 0.000% | 0.000% | 0.000% |
| Lettuce | -0.010% | 0.000% | 0.000% | 0.000% | -0.009% | 0.000% | 0.000% | 0.000% | 0.000% |
| Melons | -0.018% | 0.000% | 0.000% | 0.000% | -0.019% | 0.000% | 0.001% | 0.000% | 0.000% |
| Oats | -2.555% | -1.789% | -0.580% | 0.000% | 0.000% | 0.000% | 0.000% | -0.140% | -0.047% |
| Onions | -0.031% | -0.018% | 0.000% | 0.000% | -0.013% | 0.000% | 0.000% | 0.000% | 0.000% |
| Safflower-internal | 0.223% | 0.000% | 0.000% | 0.143% | 0.000% | 0.000% | 0.000% | 0.000% | 0.080% |
| Sugarbeets | -0.018% | 0.000% | 0.000% | 0.005% | 0.000% | -0.023% | 0.000% | 0.000% | 0.000% |
| Potatoes | -0.034% | 0.000% | 0.000% | 0.000% | -0.035% | 0.000% | 0.001% | 0.000% | 0.000% |
| Tomatoes | -0.064% | -0.055% | 0.000% | 0.001% | -0.011% | 0.000% | 0.001% | 0.000% | 0.000% |
| Wheat | -2.022% | -0.957% | -0.627% | -0.035% | 0.000% | -0.120% | 0.000% | -0.284% | 0.000% |
| Safflower-external | 17.687% | 9.527% | 3.412% | 0.000% | 0.581% | 2.487% | 0.005% | 1.676% | 0.000% |
| Acre-feet of Water | -5.411% | -2.392% | -0.950% | 0.000% | -0.291% | -1.196% | 0.000% | -0.581% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $40/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added

## Table E.29 Acreage change in SSJ Region from a $20/acre increase in profit from bermudagrass

**Change in acres from $20/acre increase in bermudagrass profit**

| 1,159,743 | Acres | 336,590 | 147,957 | 293,764 | 69,640 | 108,320 | 18,440 | 73,304 | 111,727 |
|---|---|---|---|---|---|---|---|---|---|
| | **SSJ-ALL** | **SSJ-C1** | **SSJ-C2** | **SSJ-C3** | **SSJ-C4** | **SSJ-C5** | **SSJ-C6** | **SSJ-C7** | **SSJ-C8** |
| Alfalfa | (2,528) | (1,057) | (607) | (382) | 0 | (392) | 0 | 0 | (91) |
| Barley | (2,223) | (2,223) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beans | (29,830) | (12,422) | (3,315) | (5,767) | (2,195) | (3,745) | 0 | 0 | (2,386) |
| Carrots | (575) | (206) | 0 | (39) | (274) | (56) | 0 | 0 | 0 |
| Corn-Silage | (8,028) | (1,598) | (2,454) | (1,808) | 0 | (1,041) | 0 | 0 | (1,126) |
| Cotton | (24,946) | (7,888) | (1,156) | (11,640) | (400) | (2,834) | 0 | 0 | (1,027) |
| Garlic | (18) | 0 | 0 | 0 | (18) | 0 | 0 | 0 | 0 |
| Lettuce | (14) | 0 | 0 | 0 | (14) | 0 | 0 | 0 | 0 |
| Melons | (67) | 0 | 0 | 0 | (42) | 0 | 0 | 0 | (25) |
| Oats | (5,582) | (6,337) | (2,053) | 0 | 0 | 0 | 0 | 0 | 2,807 |
| Onions | (92) | (39) | 0 | (26) | (27) | 0 | 0 | 0 | 0 |
| Safflower | (235) | 0 | 0 | (166) | 0 | 0 | 0 | 0 | (69) |
| Sugarbeets | (408) | 0 | 0 | (229) | 0 | (103) | 0 | 0 | (76) |
| Potatoes | (99) | 0 | 0 | 0 | (99) | 0 | 0 | 0 | 0 |
| Tomatoes | (307) | (122) | 0 | (142) | (24) | 0 | 0 | 0 | (19) |
| Wheat | (2,572) | (708) | (464) | (843) | 0 | (89) | 0 | 0 | (469) |
| Bermudagrass-extern | 43,516 | 15,975 | 5,252 | 12,901 | 1,817 | 5,090 | 0 | 0 | 2,480 |
| Total Acres | (34,009) | (16,624) | (4,798) | (8,141) | (1,276) | (3,170) | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $20/acre increase in bermudagrass profit**

| 1,159,743 | Acres | 336,590 | 147,957 | 293,764 | 69,640 | 108,320 | 18,440 | 73,304 | 111,727 |
|---|---|---|---|---|---|---|---|---|---|
| 3,924,962 | Ac-ft Water | 1,183,984 | 527,318 | 977,417 | 268,434 | 422,169 | 66,997 | 245,982 | 232,661 |
| 3.38 | Ac-ft/Acre | | | | | | | | |
| | **SSJ-ALL** | **SSJ-C1** | **SSJ-C2** | **SSJ-C3** | **SSJ-C4** | **SSJ-C5** | **SSJ-C6** | **SSJ-C7** | **SSJ-C8** |
| Alfalfa | -0.218% | -0.091% | -0.052% | -0.033% | 0.000% | -0.034% | 0.000% | 0.000% | -0.008% |
| Barley | -0.192% | -0.192% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -2.572% | -1.071% | -0.286% | -0.497% | -0.189% | -0.323% | 0.000% | 0.000% | -0.206% |
| Carrots | -0.050% | -0.018% | 0.000% | -0.003% | -0.024% | -0.005% | 0.000% | 0.000% | 0.000% |
| Corn-Silage | -0.692% | -0.138% | -0.212% | -0.156% | 0.000% | -0.090% | 0.000% | 0.000% | -0.097% |
| Cotton | -2.151% | -0.680% | -0.100% | -1.004% | -0.035% | -0.244% | 0.000% | 0.000% | -0.089% |
| Garlic | -0.002% | 0.000% | 0.000% | 0.000% | -0.002% | 0.000% | 0.000% | 0.000% | 0.000% |
| Lettuce | -0.001% | 0.000% | 0.000% | 0.000% | -0.001% | 0.000% | 0.000% | 0.000% | 0.000% |
| Melons | -0.006% | 0.000% | 0.000% | 0.000% | -0.004% | 0.000% | 0.000% | 0.000% | -0.002% |
| Oats | -0.481% | -0.546% | -0.177% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.242% |
| Onions | -0.008% | -0.003% | 0.000% | -0.002% | -0.002% | 0.000% | 0.000% | 0.000% | 0.000% |
| Safflower | -0.020% | 0.000% | 0.000% | -0.014% | 0.000% | 0.000% | 0.000% | 0.000% | -0.006% |
| Sugarbeets | -0.035% | 0.000% | 0.000% | -0.020% | 0.000% | -0.009% | 0.000% | 0.000% | -0.007% |
| Potatoes | -0.008% | 0.000% | 0.000% | 0.000% | -0.008% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | -0.026% | -0.011% | 0.000% | -0.012% | -0.002% | 0.000% | 0.000% | 0.000% | -0.002% |
| Wheat | -0.222% | -0.061% | -0.040% | -0.073% | 0.000% | -0.008% | 0.000% | 0.000% | -0.040% |
| Bermudagrass-extern | 3.752% | 1.377% | 0.453% | 1.112% | 0.157% | 0.439% | 0.000% | 0.000% | 0.214% |
| Total Acres | -2.932% | -1.433% | -0.414% | -0.702% | -0.110% | -0.273% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $20/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added

## Table E.30 Acreage change in SSJ Region from a $40/acre increase in profit from bermudagrass

**Change in acres from $40/acre increase in bermudagrass profit**

| Cluster share of region | | 28.7% | 12.9% | 25.9% | 6.3% | 9.7% | 1.7% | 6.4% | 8.3% |
|---|---|---|---|---|---|---|---|---|---|
| 1,088,545 | Acres | 312,670 | 140,776 | 281,723 | 69,084 | 105,179 | 18,440 | 69,834 | 90,839 |
| | **SSJ-ALL** | **SSJ-C1** | **SSJ-C2** | **SSJ-C3** | **SSJ-C4** | **SSJ-C5** | **SSJ-C6** | **SSJ-C7** | **SSJ-C8** |
| Alfalfa | (8,379) | (3,392) | (1,948) | (1,225) | 0 | (1,257) | 0 | (327) | (228) |
| Barley | (9,357) | (7,134) | 0 | 0 | 0 | 0 | 0 | 0 | (2,222) |
| Beans | (29,830) | (12,422) | (3,315) | (5,767) | (2,195) | (3,745) | 0 | 0 | (2,386) |
| Carrots | (1,846) | (662) | 0 | (124) | (880) | (180) | 0 | 0 | 0 |
| Corn-Silage | (27,106) | (5,128) | (7,877) | (5,803) | 0 | (3,341) | 0 | (1,972) | (2,984) |
| Cotton | (82,903) | (25,314) | (3,711) | (37,356) | (1,284) | (9,096) | 0 | (3,408) | (2,733) |
| Garlic | (58) | 0 | 0 | 0 | (58) | 0 | 0 | 0 | 0 |
| Lettuce | (45) | 0 | 0 | 0 | (45) | 0 | 0 | 0 | 0 |
| Melons | (201) | 0 | 0 | 0 | (135) | 0 | 0 | 0 | (66) |
| Oats | (46,238) | (20,336) | (6,588) | 0 | 0 | 0 | 0 | (1,666) | (17,648) |
| Onions | (296) | (124) | 0 | (85) | (87) | 0 | 0 | 0 | 0 |
| Safflower | (772) | 0 | 0 | (532) | 0 | 0 | 0 | 0 | (239) |
| Sugarbeets | (1,252) | 0 | 0 | (735) | 0 | (331) | 0 | 0 | (186) |
| Potatoes | (316) | 0 | 0 | 0 | (316) | 0 | 0 | 0 | 0 |
| Tomatoes | (975) | (392) | 0 | (456) | (77) | 0 | 0 | 0 | (49) |
| Wheat | (9,477) | (2,271) | (1,488) | (2,706) | 0 | (284) | 0 | (357) | (2,371) |
| Bermudagrass-extern | 113,842 | 36,632 | 12,949 | 34,607 | 3,245 | 11,923 | 0 | 4,260 | 10,226 |
| Total Acres | (105,207) | (40,544) | (11,979) | (20,182) | (1,833) | (6,311) | 0 | (3,470) | (20,888) |

**Percent regional change in cluster acreage from $40/acre increase in bermudagrass profit**

| 1,088,545 | Acres | 312,670 | 140,776 | 281,723 | 69,084 | 105,179 | 18,440 | 69,834 | 90,839 |
|---|---|---|---|---|---|---|---|---|---|
| 3,924,962 | Ac-ft Water | 1,183,984 | 527,318 | 977,417 | 268,434 | 422,169 | 66,997 | 245,982 | 232,661 |
| 3.61 | Ac-ft/Acre | | | | | | | | |
| | **SSJ-ALL** | **SSJ-C1** | **SSJ-C2** | **SSJ-C3** | **SSJ-C4** | **SSJ-C5** | **SSJ-C6** | **SSJ-C7** | **SSJ-C8** |
| Alfalfa | -0.770% | -0.312% | -0.179% | -0.113% | 0.000% | -0.115% | 0.000% | -0.030% | -0.021% |
| Barley | -0.860% | -0.655% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.204% |
| Beans | -2.740% | -1.141% | -0.305% | -0.530% | -0.202% | -0.344% | 0.000% | 0.000% | -0.219% |
| Carrots | -0.170% | -0.061% | 0.000% | -0.011% | -0.081% | -0.017% | 0.000% | 0.000% | 0.000% |
| Corn-Silage | -2.490% | -0.471% | -0.724% | -0.533% | 0.000% | -0.307% | 0.000% | -0.181% | -0.274% |
| Cotton | -7.616% | -2.326% | -0.341% | -3.432% | -0.118% | -0.836% | 0.000% | -0.313% | -0.251% |
| Garlic | -0.005% | 0.000% | 0.000% | 0.000% | -0.005% | 0.000% | 0.000% | 0.000% | 0.000% |
| Lettuce | -0.004% | 0.000% | 0.000% | 0.000% | -0.004% | 0.000% | 0.000% | 0.000% | 0.000% |
| Melons | -0.018% | 0.000% | 0.000% | 0.000% | -0.012% | 0.000% | 0.000% | 0.000% | -0.006% |
| Oats | -4.248% | -1.868% | -0.605% | 0.000% | 0.000% | 0.000% | 0.000% | -0.153% | -1.621% |
| Onions | -0.027% | -0.011% | 0.000% | -0.008% | -0.008% | 0.000% | 0.000% | 0.000% | 0.000% |
| Safflower | -0.071% | 0.000% | 0.000% | -0.049% | 0.000% | 0.000% | 0.000% | 0.000% | -0.022% |
| Sugarbeets | -0.115% | 0.000% | 0.000% | -0.068% | 0.000% | -0.030% | 0.000% | 0.000% | -0.017% |
| Potatoes | -0.029% | 0.000% | 0.000% | 0.000% | -0.029% | 0.000% | 0.000% | 0.000% | 0.000% |
| Tomatoes | -0.090% | -0.036% | 0.000% | -0.042% | -0.007% | 0.000% | 0.000% | 0.000% | -0.005% |
| Wheat | -0.871% | -0.209% | -0.137% | -0.249% | 0.000% | -0.026% | 0.000% | -0.033% | -0.218% |
| Bermudagrass-extern | 10.458% | 3.365% | 1.190% | 3.179% | 0.298% | 1.095% | 0.000% | 0.391% | 0.939% |
| Total Acres | -9.665% | -3.725% | -1.100% | -1.854% | -0.168% | -0.580% | 0.000% | -0.319% | -1.919% |

Acres and Ac-feet values presented here represent the values used in the $40/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added

## Table E.31 Acreage changes in SCA Region from a $20/acre increase in profit from canola

**Change in acres from $20/acre increase in canola profit**

| 599,292 | Acres | 188,280 | 32,294 | 45,831 | 167,712 | 89,223 | 75,953 |
|---|---|---|---|---|---|---|---|
| | **SCA-ALL** | **SCA-C1** | **SCA-C2** | **SCA-C3** | **SCA-C4** | **SCA-C5** | **SCA-C6** |
| Alfalfa | 2,555 | 247 | 9 | 241 | 423 | 901 | 734 |
| Barley | (850) | (850) | 0 | 0 | 0 | 0 | 0 |
| Beans | (545) | (484) | (61) | 0 | 0 | 0 | 0 |
| Bermudagrass | 965 | (27) | 0 | 0 | 63 | 0 | 929 |
| Broccoli | (51) | (84) | 0 | (13) | (19) | 47 | 16 |
| Carrots | 24 | (66) | 0 | 0 | (18) | 80 | 28 |
| Sweet Corn | 175 | (5) | 18 | 0 | 0 | 162 | 0 |
| Cotton | 5,068 | (638) | 0 | (378) | 6,084 | 0 | 0 |
| Lettuce | (30) | (61) | 0 | (9) | (7) | 44 | 4 |
| Melons | 13 | (95) | 4 | 0 | 0 | 105 | 0 |
| Oats | (13,979) | (13,979) | 0 | 0 | 0 | 0 | 0 |
| Onions | (29) | (17) | (0) | (3) | (12) | 1 | 2 |
| Potatoes | (30) | (31) | 1 | 0 | 0 | 0 | 0 |
| Sudangrass | (62,923) | 0 | 0 | 0 | (35,171) | (11,076) | (16,676) |
| Sugarbeets | 1,062 | (3) | 0 | 0 | 143 | 223 | 699 |
| Wheat | (3,121) | (2,304) | 0 | (143) | (328) | (173) | (174) |
| Canola | 71,753 | 18,434 | 30 | 305 | 28,842 | 9,694 | 14,447 |
| Acre-feet of Water | (412) | (412) | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $20/acre increase in canola profit**

| 599,292 | Acres | 188,280 | 32,294 | 45,831 | 167,712 | 89,223 | 75,953 |
|---|---|---|---|---|---|---|---|
| 2,852,602 | Ac-ft Water | 837,987 | 148,124 | 250,336 | 834,317 | 413,630 | 368,209 |
| 4.8 | Ac-ft/Acre | | | | | | |
| | **SCA-ALL** | **SCA-C1** | **SCA-C2** | **SCA-C3** | **SCA-C4** | **SCA-C5** | **SCA-C6** |
| Alfalfa | 0.426% | 0.041% | 0.001% | 0.040% | 0.071% | 0.150% | 0.122% |
| Barley | -0.142% | -0.142% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -0.091% | -0.081% | -0.010% | 0.000% | 0.000% | 0.000% | 0.000% |
| Bermudagrass | 0.161% | -0.005% | 0.000% | 0.000% | 0.011% | 0.000% | 0.155% |
| Broccoli | -0.009% | -0.014% | 0.000% | -0.002% | -0.003% | 0.008% | 0.003% |
| Carrots | 0.004% | -0.011% | 0.000% | 0.000% | -0.003% | 0.013% | 0.005% |
| Sweet Corn | 0.029% | -0.001% | 0.003% | 0.000% | 0.000% | 0.027% | 0.000% |
| Cotton | 0.846% | -0.107% | 0.000% | -0.063% | 1.015% | 0.000% | 0.000% |
| Lettuce | -0.005% | -0.010% | 0.000% | -0.002% | -0.001% | 0.007% | 0.001% |
| Melons | 0.002% | -0.016% | 0.001% | 0.000% | 0.000% | 0.018% | 0.000% |
| Oats | -2.333% | -2.333% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Onions | -0.005% | -0.003% | 0.000% | 0.000% | -0.002% | 0.000% | 0.000% |
| Potatoes | -0.005% | -0.005% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sudangrass | -10.500% | 0.000% | 0.000% | 0.000% | -5.869% | -1.848% | -2.783% |
| Sugarbeets | 0.177% | 0.000% | 0.000% | 0.000% | 0.024% | 0.037% | 0.117% |
| Wheat | -0.521% | -0.384% | 0.000% | -0.024% | -0.055% | -0.029% | -0.029% |
| Canola | 11.973% | 3.076% | 0.005% | 0.051% | 4.813% | 1.618% | 2.411% |
| Acre-feet of Water | -0.014% | -0.014% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $20/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.

## Table E.32 Acreage change in SCA Region from a $40/acre increase in profit from canola

**Change in acres from $40/acre increase in canola profit**

| Cluster share of region | | 31.4% | 5.4% | 7.6% | 28.0% | 14.9% | 12.7% |
|---|---|---|---|---|---|---|---|
| 599,292 | Acres | 188,280 | 32,294 | 45,831 | 167,712 | 89,223 | 75,953 |
| | **SCA-ALL** | **SCA-C1** | **SCA-C2** | **SCA-C3** | **SCA-C4** | **SCA-C5** | **SCA-C6** |
| Alfalfa | (1,333) | (1,143) | 139 | (146) | (852) | 379 | 291 |
| Barley | (1,968) | (1,968) | 0 | 0 | 0 | 0 | 0 |
| Beans | (2,833) | (1,894) | (940) | 0 | 0 | 0 | 0 |
| Bermudagrass | (1,353) | (905) | 0 | 0 | (468) | 0 | 20 |
| Broccoli | (774) | (327) | 0 | (72) | (186) | (145) | (44) |
| Carrots | (750) | (258) | 0 | 0 | (173) | (243) | (75) |
| Sweet Corn | (226) | (519) | 281 | 0 | 0 | 13 | 0 |
| Cotton | (22,430) | (3,008) | 0 | (14,031) | (5,392) | 0 | 0 |
| Lettuce | (505) | (239) | 0 | (53) | (69) | (133) | (10) |
| Melons | (764) | (634) | 55 | (123) | 0 | (62) | 0 |
| Oats | (13,979) | (13,979) | 0 | 0 | 0 | 0 | 0 |
| Onions | (234) | (54) | (5) | (10) | (78) | (52) | (34) |
| Potatoes | (194) | (206) | 12 | 0 | 0 | 0 | 0 |
| Sudangrass | (62,923) | 0 | 0 | 0 | (35,171) | (11,076) | (16,676) |
| Sugarbeets | (1,112) | (285) | 0 | 0 | (895) | 18 | 51 |
| Wheat | (8,347) | (5,453) | 0 | (384) | (1,366) | (570) | (574) |
| Canola | 119,780 | 30,909 | 459 | 14,819 | 44,651 | 11,882 | 17,060 |
| Acre-feet of Water | (147,289) | (29,985) | 0 | (48,236) | (52,909) | (6,644) | (9,515) |

**Percent regional change in cluster acreage from $40/acre increase in canola profit**

| 599,292 | Acres | 188,280 | 32,294 | 45,831 | 167,712 | 89,223 | 75,953 |
|---|---|---|---|---|---|---|---|
| 2,705,725 | Ac-ft Water | 808,413 | 148,124 | 202,101 | 781,408 | 406,986 | 358,694 |
| 4.5 | Ac-ft/Acre | | | | | | |
| | **SCA-ALL** | **SCA-C1** | **SCA-C2** | **SCA-C3** | **SCA-C4** | **SCA-C5** | **SCA-C6** |
| Alfalfa | -0.222% | -0.191% | 0.023% | -0.024% | -0.142% | 0.063% | 0.049% |
| Barley | -0.328% | -0.328% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -0.473% | -0.316% | -0.157% | 0.000% | 0.000% | 0.000% | 0.000% |
| Bermudagrass | -0.226% | -0.151% | 0.000% | 0.000% | -0.078% | 0.000% | 0.003% |
| Broccoli | -0.129% | -0.055% | 0.000% | -0.012% | -0.031% | -0.024% | -0.007% |
| Carrots | -0.125% | -0.043% | 0.000% | 0.000% | -0.029% | -0.041% | -0.012% |
| Sweet Corn | -0.038% | -0.087% | 0.047% | 0.000% | 0.000% | 0.002% | 0.000% |
| Cotton | -3.743% | -0.502% | 0.000% | -2.341% | -0.900% | 0.000% | 0.000% |
| Lettuce | -0.084% | -0.040% | 0.000% | -0.009% | -0.012% | -0.022% | -0.002% |
| Melons | -0.127% | -0.106% | 0.009% | -0.020% | 0.000% | -0.010% | 0.000% |
| Oats | -2.333% | -2.333% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Onions | -0.039% | -0.009% | -0.001% | -0.002% | -0.013% | -0.009% | -0.006% |
| Potatoes | -0.032% | -0.034% | 0.002% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sudangrass | -10.500% | 0.000% | 0.000% | 0.000% | -5.869% | -1.848% | -2.783% |
| Sugarbeets | -0.185% | -0.048% | 0.000% | 0.000% | -0.149% | 0.003% | 0.009% |
| Wheat | -1.393% | -0.910% | 0.000% | -0.064% | -0.228% | -0.095% | -0.096% |
| Canola | 19.987% | 5.158% | 0.077% | 2.473% | 7.451% | 1.983% | 2.847% |
| Acre-feet of Water | -5.444% | -1.108% | 0.000% | -1.783% | -1.955% | -0.246% | -0.352% |

Acres and Ac-feet values presented here represent the values used in the $40/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.

## Table E.33 Acreage change in SCA Region from a $20/acre increase in profit from sweet sorghum

**Change in acres from $20/acre increase in sweet sorghum profit**

| 590,230 | Acres | 179,236 | 32,293 | 45,830 | 167,712 | 89,214 | 75,945 |
|---|---|---|---|---|---|---|---|
| | **SCA-ALL** | **SCA-C1** | **SCA-C2** | **SCA-C3** | **SCA-C4** | **SCA-C5** | **SCA-C6** |
| Alfalfa | (516) | (516) | 0 | 0 | 0 | 0 | 0 |
| Barley | (87) | (87) | 0 | 0 | 0 | 0 | 0 |
| Beans | (294) | (294) | 0 | 0 | 0 | 0 | 0 |
| Bermudagrass | (269) | (269) | 0 | 0 | 0 | 0 | 0 |
| Broccoli | (51) | (51) | 0 | 0 | 0 | 0 | 0 |
| Carrots | (40) | (40) | 0 | 0 | 0 | 0 | 0 |
| Sweet Corn | (161) | (161) | 0 | 0 | 0 | 0 | 0 |
| Cotton | (941) | (941) | 0 | 0 | 0 | 0 | 0 |
| Lettuce | (37) | (37) | 0 | 0 | 0 | 0 | 0 |
| Melons | (140) | (140) | 0 | 0 | 0 | 0 | 0 |
| Oats | (13,979) | (13,979) | 0 | 0 | 0 | 0 | 0 |
| Onions | (6) | (6) | 0 | 0 | 0 | 0 | 0 |
| Potatoes | (46) | (46) | 0 | 0 | 0 | 0 | 0 |
| Sudangrass | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sugarbeets | (88) | (88) | 0 | 0 | 0 | 0 | 0 |
| Wheat | (274) | (274) | 0 | 0 | 0 | 0 | 0 |
| Sweet Sorghum | 7,921 | 7,921 | 0 | 0 | 0 | 0 | 0 |
| Total Acres | (9,007) | (9,007) | 0 | 0 | 0 | 0 | 0 |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $20/acre increase in sweet sorghum profit**

| 590,230 | Acres | 179,236 | 32,293 | 45,830 | 167,712 | 89,214 | 75,945 |
|---|---|---|---|---|---|---|---|
| 2,853,014 | Ac-ft Water | 838,399 | 148,124 | 250,336 | 834,317 | 413,630 | 368,209 |
| 4.8 | Ac-ft/Acre | | | | | | |
| | **SCA-ALL** | **SCA-C1** | **SCA-C2** | **SCA-C3** | **SCA-C4** | **SCA-C5** | **SCA-C6** |
| Alfalfa | -0.087% | -0.087% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Barley | -0.015% | -0.015% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -0.050% | -0.050% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Bermudagrass | -0.046% | -0.046% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Broccoli | -0.009% | -0.009% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Carrots | -0.007% | -0.007% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sweet Corn | -0.027% | -0.027% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Cotton | -0.159% | -0.159% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Lettuce | -0.006% | -0.006% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Melons | -0.024% | -0.024% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Oats | -2.368% | -2.368% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Onions | -0.001% | -0.001% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Potatoes | -0.008% | -0.008% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sudangrass | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sugarbeets | -0.015% | -0.015% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Wheat | -0.046% | -0.046% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sweet Sorghum | 1.342% | 1.342% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Total Acres | -1.526% | -1.526% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Acre-feet of Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $20/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.

## Table E.34 Acreage change in SCA Region from a $40/acre increase in profit from sweet sorghum

**Change in acres from $40/acre increase in sweet sorghum profit**

| Cluster share of region | | 31.9% | 5.7% | 8.1% | 27.3% | 14.9% | 12.1% |
|---|---|---|---|---|---|---|---|
| 565,480 | Acres | 180,378 | 32,293 | 45,831 | 154,165 | 84,274 | 68,538 |
| | **SCA-ALL** | **SCA-C1** | **SCA-C2** | **SCA-C3** | **SCA-C4** | **SCA-C5** | **SCA-C6** |
| Alfalfa | (7,364) | (2,785) | 0 | (150) | (3,332) | (621) | (477) |
| Barley | (472) | (472) | 0 | 0 | 0 | 0 | 0 |
| Beans | (1,586) | (1,586) | 0 | 0 | 0 | 0 | 0 |
| Bermudagrass | (3,121) | (1,450) | 0 | 0 | (942) | 0 | (728) |
| Broccoli | (612) | (274) | 0 | (72) | (142) | (95) | (29) |
| Carrots | (557) | (216) | 0 | 0 | (132) | (159) | (49) |
| Sweet Corn | (1,000) | (868) | 0 | 0 | 0 | (132) | 0 |
| Cotton | (22,430) | (3,008) | 0 | (14,031) | (5,392) | 0 | 0 |
| Lettuce | (401) | (201) | 0 | (54) | (53) | (87) | (7) |
| Melons | (993) | (758) | 0 | (124) | 0 | (112) | 0 |
| Oats | (13,979) | (13,979) | 0 | 0 | 0 | 0 | 0 |
| Onions | (119) | (35) | 0 | (10) | (39) | (21) | (14) |
| Potatoes | (246) | (246) | 0 | 0 | 0 | 0 | 0 |
| Sudangrass | (62,923) | 0 | 0 | 0 | (35,171) | (11,076) | (16,676) |
| Sugarbeets | (3,111) | (477) | 0 | 0 | (1,917) | (182) | (535) |
| Wheat | (2,057) | (1,479) | 0 | (385) | (56) | (68) | (69) |
| Sweet Sorghum | 87,214 | 19,967 | 0 | 14,826 | 33,631 | 7,614 | 11,176 |
| Total Acres | (33,757) | (7,865) | 0 | 0 | (13,546) | (4,940) | (7,406) |
| Acre-feet of Water | (6,303) | 0 | 0 | (6,303) | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $40/acre increase in sweet sorghum profit**

| 565,480 | Acres | 180,378 | 32,293 | 45,831 | 154,165 | 84,274 | 68,538 |
|---|---|---|---|---|---|---|---|
| 2,846,711 | Ac-ft Water | 838,399 | 148,124 | 244,033 | 834,317 | 413,630 | 368,209 |
| 5.0 | Ac-ft/Acre | | | | | | |
| | **SCA-ALL** | **SCA-C1** | **SCA-C2** | **SCA-C3** | **SCA-C4** | **SCA-C5** | **SCA-C6** |
| Alfalfa | -1.302% | -0.492% | 0.000% | -0.026% | -0.589% | -0.110% | -0.084% |
| Barley | -0.083% | -0.083% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -0.280% | -0.280% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Bermudagrass | -0.552% | -0.256% | 0.000% | 0.000% | -0.167% | 0.000% | -0.129% |
| Broccoli | -0.108% | -0.048% | 0.000% | -0.013% | -0.025% | -0.017% | -0.005% |
| Carrots | -0.098% | -0.038% | 0.000% | 0.000% | -0.023% | -0.028% | -0.009% |
| Sweet Corn | -0.177% | -0.153% | 0.000% | 0.000% | 0.000% | -0.023% | 0.000% |
| Cotton | -3.967% | -0.532% | 0.000% | -2.481% | -0.953% | 0.000% | 0.000% |
| Lettuce | -0.071% | -0.035% | 0.000% | -0.010% | -0.009% | -0.015% | -0.001% |
| Melons | -0.176% | -0.134% | 0.000% | -0.022% | 0.000% | -0.020% | 0.000% |
| Oats | -2.472% | -2.472% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Onions | -0.021% | -0.006% | 0.000% | -0.002% | -0.007% | -0.004% | -0.002% |
| Potatoes | -0.043% | -0.043% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sudangrass | -11.127% | 0.000% | 0.000% | 0.000% | -6.220% | -1.959% | -2.949% |
| Sugarbeets | -0.550% | -0.084% | 0.000% | 0.000% | -0.339% | -0.032% | -0.095% |
| Wheat | -0.364% | -0.262% | 0.000% | -0.068% | -0.010% | -0.012% | -0.012% |
| Sweet Sorghum | 15.423% | 3.531% | 0.000% | 2.622% | 5.947% | 1.347% | 1.976% |
| Total Acres | -5.970% | -1.391% | 0.000% | 0.000% | -2.396% | -0.874% | -1.310% |
| Acre-feet of Water | -0.221% | 0.000% | 0.000% | -0.221% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $40/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.

## Table E.35 Acreage change in SCA Region from a $20/acre increase in profit from sugarbeets

**Change in acres from $20/acre increase in sugarbeet profit**

| 597,523 | Acres | 187,703 | 32,293 | 45,830 | 167,712 | 88,915 | 75,069 |
|---|---|---|---|---|---|---|---|
| | **SCA-ALL** | **SCA-C1** | **SCA-C2** | **SCA-C3** | **SCA-C4** | **SCA-C5** | **SCA-C6** |
| Alfalfa | (144) | (20) | 0 | 0 | 0 | (46) | (77) |
| Barley | (0) | (0) | 0 | 0 | 0 | 0 | 0 |
| Beans | (9) | (9) | 0 | 0 | 0 | 0 | 0 |
| Bermudagrass | (116) | (10) | 0 | 0 | 0 | 0 | (106) |
| Broccoli | (9) | (2) | 0 | 0 | 0 | (4) | (3) |
| Carrots | (13) | (1) | 0 | 0 | 0 | (7) | (5) |
| Sweet Corn | (15) | (6) | 0 | 0 | 0 | (9) | 0 |
| Cotton | (2,056) | (33) | 0 | 0 | (2,024) | 0 | 0 |
| Lettuce | (6) | (1) | 0 | 0 | 0 | (4) | (1) |
| Melons | (12) | (5) | 0 | 0 | 0 | (7) | 0 |
| Oats | (758) | (758) | 0 | 0 | 0 | 0 | 0 |
| Onions | (2) | (0) | 0 | 0 | 0 | (1) | (1) |
| Potatoes | (2) | (2) | 0 | 0 | 0 | 0 | 0 |
| Sudangrass | (1,426) | 0 | 0 | 0 | 552 | (510) | (1,469) |
| Sugarbeets-internal | 2,792 | 271 | 0 | 0 | 1,472 | 278 | 771 |
| Wheat | 8 | (1) | 0 | 0 | 0 | 3 | 7 |
| Sugarbeets-external | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Acres | (1,768) | (577) | 0 | 0 | 0 | (307) | (884) |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $20/acre increase in sugarbeet profit**

| 597,523 | Acres | 187,703 | 32,293 | 45,830 | 167,712 | 88,915 | 75,069 |
|---|---|---|---|---|---|---|---|
| 2,853,014 | Ac-ft Water | 838,399 | 148,124 | 250,336 | 834,317 | 413,630 | 368,209 |
| 4.8 | Ac-ft/Acre | | | | | | |
| | **SCA-ALL** | **SCA-C1** | **SCA-C2** | **SCA-C3** | **SCA-C4** | **SCA-C5** | **SCA-C6** |
| Alfalfa | -0.024% | -0.003% | 0.000% | 0.000% | 0.000% | -0.008% | -0.013% |
| Barley | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -0.002% | -0.002% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Bermudagrass | -0.019% | -0.002% | 0.000% | 0.000% | 0.000% | 0.000% | -0.018% |
| Broccoli | -0.001% | 0.000% | 0.000% | 0.000% | 0.000% | -0.001% | 0.000% |
| Carrots | -0.002% | 0.000% | 0.000% | 0.000% | 0.000% | -0.001% | -0.001% |
| Sweet Corn | -0.002% | -0.001% | 0.000% | 0.000% | 0.000% | -0.001% | 0.000% |
| Cotton | -0.344% | -0.005% | 0.000% | 0.000% | -0.339% | 0.000% | 0.000% |
| Lettuce | -0.001% | 0.000% | 0.000% | 0.000% | 0.000% | -0.001% | 0.000% |
| Melons | -0.002% | -0.001% | 0.000% | 0.000% | 0.000% | -0.001% | 0.000% |
| Oats | -0.127% | -0.127% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Onions | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Potatoes | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sudangrass | -0.239% | 0.000% | 0.000% | 0.000% | 0.092% | -0.085% | -0.246% |
| Sugarbeets-internal | 0.467% | 0.045% | 0.000% | 0.000% | 0.246% | 0.046% | 0.129% |
| Wheat | 0.001% | 0.000% | 0.000% | 0.000% | 0.000% | 0.001% | 0.001% |
| Sugarbeets-external | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Total Acres | -0.296% | -0.097% | 0.000% | 0.000% | 0.000% | -0.051% | -0.148% |
| Acre-feet of Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $20/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added

## Table E.36 Acreage change in SCA Region from a $40/acre increase in profit from sugarbeets

**Change in acres from $40/acre increase in sugarbeet profit**

| Cluster share of region | | 31.5% | 5.4% | 7.3% | 28.3% | 14.9% | 12.5% |
|---|---|---|---|---|---|---|---|
| 592,894 | Acres | 186,975 | 32,293 | 43,512 | 167,712 | 88,513 | 73,889 |
| | **SCA-ALL** | **SCA-C1** | **SCA-C2** | **SCA-C3** | **SCA-C4** | **SCA-C5** | **SCA-C6** |
| Alfalfa | (518) | (20) | 0 | (375) | 0 | (46) | (77) |
| Barley | (0) | (0) | 0 | 0 | 0 | 0 | 0 |
| Beans | (9) | (9) | 0 | 0 | 0 | 0 | 0 |
| Bermudagrass | (116) | (10) | 0 | 0 | 0 | 0 | (106) |
| Broccoli | (32) | (2) | 0 | (23) | 0 | (4) | (3) |
| Carrots | (13) | (1) | 0 | 0 | 0 | (7) | (5) |
| Sweet Corn | (15) | (6) | 0 | 0 | 0 | (9) | 0 |
| Cotton | (17,875) | (33) | 0 | (14,031) | (3,812) | 0 | 0 |
| Lettuce | (23) | (1) | 0 | (17) | 0 | (4) | (1) |
| Melons | (78) | (5) | 0 | (67) | 0 | (7) | 0 |
| Oats | (1,729) | (1,729) | 0 | 0 | 0 | 0 | 0 |
| Onions | (4) | (0) | 0 | (2) | 0 | (1) | (1) |
| Potatoes | (2) | (2) | 0 | 0 | 0 | 0 | 0 |
| Sudangrass | (3,528) | 0 | 0 | 0 | 1,040 | (1,168) | (3,400) |
| Sugarbeets-internal | 5,342 | 514 | 0 | 0 | 2,772 | 534 | 1,522 |
| Wheat | (25) | (1) | 0 | (33) | 0 | 3 | 7 |
| Sugarbeets-external | 12,231 | 0 | 0 | 12,231 | 0 | 0 | 0 |
| Total Acres | (6,397) | (1,305) | 0 | (2,318) | 0 | (710) | (2,064) |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $40/acre increase in sugarbeet profit**

| 592,894 | Acres | 186,975 | 32,293 | 43,512 | 167,712 | 88,513 | 73,889 |
|---|---|---|---|---|---|---|---|
| 2,853,014 | Ac-ft Water | 838,399 | 148,124 | 250,336 | 834,317 | 413,630 | 368,209 |
| 4.8 | Ac-ft/Acre | | | | | | |
| | **SCA-ALL** | **SCA-C1** | **SCA-C2** | **SCA-C3** | **SCA-C4** | **SCA-C5** | **SCA-C6** |
| Alfalfa | -0.087% | -0.003% | 0.000% | -0.063% | 0.000% | -0.008% | -0.013% |
| Barley | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -0.002% | -0.002% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Bermudagrass | -0.020% | -0.002% | 0.000% | 0.000% | 0.000% | 0.000% | -0.018% |
| Broccoli | -0.005% | 0.000% | 0.000% | -0.004% | 0.000% | -0.001% | 0.000% |
| Carrots | -0.002% | 0.000% | 0.000% | 0.000% | 0.000% | -0.001% | -0.001% |
| Sweet Corn | -0.003% | -0.001% | 0.000% | 0.000% | 0.000% | -0.002% | 0.000% |
| Cotton | -3.015% | -0.006% | 0.000% | -2.366% | -0.643% | 0.000% | 0.000% |
| Lettuce | -0.004% | 0.000% | 0.000% | -0.003% | 0.000% | -0.001% | 0.000% |
| Melons | -0.013% | -0.001% | 0.000% | -0.011% | 0.000% | -0.001% | 0.000% |
| Oats | -0.292% | -0.292% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Onions | -0.001% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Potatoes | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sudangrass | -0.595% | 0.000% | 0.000% | 0.000% | 0.175% | -0.197% | -0.573% |
| Sugarbeets-internal | 0.901% | 0.087% | 0.000% | 0.000% | 0.468% | 0.090% | 0.257% |
| Wheat | -0.004% | 0.000% | 0.000% | -0.006% | 0.000% | 0.001% | 0.001% |
| Sugarbeets-external | 2.063% | 0.000% | 0.000% | 2.063% | 0.000% | 0.000% | 0.000% |
| Total Acres | -1.079% | -0.220% | 0.000% | -0.391% | 0.000% | -0.120% | -0.348% |
| Acre-feet of Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $40/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added.

## Table E.37 Acreage change in SCA Region from a $20/acre increase in profit from safflower

**Change in acres from $20/acre increase in safflower profit**

| 599,292 | Acres | 188,280 | 32,294 | 45,831 | 167,712 | 89,223 | 75,953 |
|---|---|---|---|---|---|---|---|
| | **SCA-ALL** | **SCA-C1** | **SCA-C2** | **SCA-C3** | **SCA-C4** | **SCA-C5** | **SCA-C6** |
| Alfalfa | 2,498 | 233 | 8 | 244 | 434 | 871 | 708 |
| Barley | (861) | (861) | 0 | 0 | 0 | 0 | 0 |
| Beans | (554) | (498) | (56) | 0 | 0 | 0 | 0 |
| Bermudagrass | 919 | (36) | 0 | 0 | 65 | 0 | 890 |
| Broccoli | (60) | (86) | 0 | (13) | (19) | 43 | 15 |
| Carrots | 11 | (68) | 0 | 0 | (18) | 72 | 25 |
| Sweet Corn | 161 | (10) | 16 | 0 | 0 | 155 | 0 |
| Cotton | 4,738 | (674) | 0 | (386) | 5,798 | 0 | 0 |
| Lettuce | (37) | (63) | 0 | (10) | (7) | 39 | 3 |
| Melons | 2 | (101) | 3 | 0 | 0 | 99 | 0 |
| Oats | (13,979) | (13,979) | 0 | 0 | 0 | 0 | 0 |
| Onions | (31) | (17) | (0) | (3) | (12) | 0 | 1 |
| Potatoes | (32) | (33) | 1 | 0 | 0 | 0 | 0 |
| Sudangrass | (62,923) | 0 | 0 | 0 | (35,171) | (11,076) | (16,676) |
| Sugarbeets | 1,025 | (6) | 0 | 0 | 147 | 214 | 670 |
| Wheat | (3,169) | (2,336) | 0 | (145) | (336) | (176) | (177) |
| Safflower | 72,347 | 18,572 | 28 | 312 | 29,121 | 9,767 | 14,548 |
| Total Acres | 55 | 37 | 0 | 0 | 0 | 9 | 8 |
| Acre-feet of Water | (192) | (192) | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $20/acre increase in safflower profit**

| 599,292 | Acres | 188,280 | 32,294 | 45,831 | 167,712 | 89,223 | 75,953 |
|---|---|---|---|---|---|---|---|
| 2,852,822 | Ac-ft Water | 838,207 | 148,124 | 250,336 | 834,317 | 413,630 | 368,209 |
| 4.8 | Ac-ft/Acre | | | | | | |
| | **SCA-ALL** | **SCA-C1** | **SCA-C2** | **SCA-C3** | **SCA-C4** | **SCA-C5** | **SCA-C6** |
| Alfalfa | 0.417% | 0.039% | 0.001% | 0.041% | 0.072% | 0.145% | 0.118% |
| Barley | -0.144% | -0.144% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -0.092% | -0.083% | -0.009% | 0.000% | 0.000% | 0.000% | 0.000% |
| Bermudagrass | 0.153% | -0.006% | 0.000% | 0.000% | 0.011% | 0.000% | 0.149% |
| Broccoli | -0.010% | -0.014% | 0.000% | -0.002% | -0.003% | 0.007% | 0.002% |
| Carrots | 0.002% | -0.011% | 0.000% | 0.000% | -0.003% | 0.012% | 0.004% |
| Sweet Corn | 0.027% | -0.002% | 0.003% | 0.000% | 0.000% | 0.026% | 0.000% |
| Cotton | 0.791% | -0.113% | 0.000% | -0.064% | 0.968% | 0.000% | 0.000% |
| Lettuce | -0.006% | -0.011% | 0.000% | -0.002% | -0.001% | 0.007% | 0.001% |
| Melons | 0.000% | -0.017% | 0.001% | 0.000% | 0.000% | 0.017% | 0.000% |
| Oats | -2.333% | -2.333% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Onions | -0.005% | -0.003% | 0.000% | 0.000% | -0.002% | 0.000% | 0.000% |
| Potatoes | -0.005% | -0.005% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sudangrass | -10.500% | 0.000% | 0.000% | 0.000% | -5.869% | -1.848% | -2.783% |
| Sugarbeets | 0.171% | -0.001% | 0.000% | 0.000% | 0.024% | 0.036% | 0.112% |
| Wheat | -0.529% | -0.390% | 0.000% | -0.024% | -0.056% | -0.029% | -0.030% |
| Safflower | 12.072% | 3.099% | 0.005% | 0.052% | 4.859% | 1.630% | 2.428% |
| Total Acres | 0.009% | 0.006% | 0.000% | 0.000% | 0.000% | 0.001% | 0.001% |
| Acre-feet of Water | -0.007% | -0.007% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $20/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added.

## Table E.38 Acreage change in SCA Region from a $40/acre increase in profit from safflower

**Change in acres from $40/acre increase in safflower profit**

| Cluster share of region | | 31.4% | 5.4% | 7.6% | 28.0% | 14.9% | 12.7% |
|---|---|---|---|---|---|---|---|
| 599,292 | Acres | 188,280 | 32,294 | 45,831 | 167,712 | 89,223 | 75,953 |
| | **SCA-ALL** | **SCA-C1** | **SCA-C2** | **SCA-C3** | **SCA-C4** | **SCA-C5** | **SCA-C6** |
| Alfalfa | (1,169) | (1,101) | 135 | (127) | (789) | 404 | 310 |
| Barley | (1,934) | (1,934) | 0 | 0 | 0 | 0 | 0 |
| Beans | (2,767) | (1,851) | (916) | 0 | 0 | 0 | 0 |
| Bermudagrass | (1,268) | (878) | 0 | 0 | (446) | 0 | 56 |
| Broccoli | (749) | (320) | 0 | (70) | (180) | (138) | (42) |
| Carrots | (723) | (252) | 0 | 0 | (168) | (232) | (71) |
| Sweet Corn | (213) | (504) | 272 | 0 | 0 | 19 | 0 |
| Cotton | (22,430) | (3,008) | 0 | (14,031) | (5,392) | 0 | 0 |
| Lettuce | (489) | (234) | 0 | (52) | (67) | (127) | (10) |
| Melons | (738) | (618) | 53 | (118) | 0 | (56) | 0 |
| Oats | (13,979) | (13,979) | 0 | 0 | 0 | 0 | 0 |
| Onions | (228) | (53) | (5) | (10) | (76) | (50) | (33) |
| Potatoes | (189) | (200) | 11 | 0 | 0 | 0 | 0 |
| Sudangrass | (62,923) | 0 | 0 | 0 | (35,171) | (11,076) | (16,676) |
| Sugarbeets | (1,023) | (277) | 0 | 0 | (850) | 26 | 77 |
| Wheat | (8,190) | (5,359) | 0 | (376) | (1,334) | (559) | (562) |
| Safflower | 119,068 | 30,606 | 450 | 14,784 | 44,473 | 11,796 | 16,959 |
| Total Acres | 55 | 37 | 0 | 0 | 0 | 9 | 8 |
| Acre-feet of Water | (141,348) | (28,417) | 0 | (47,406) | (50,903) | (6,003) | (8,619) |

**Percent regional change in cluster acreage from $40/acre increase in safflower profit**

| 599,292 | Acres | 188,280 | 32,294 | 45,831 | 167,712 | 89,223 | 75,953 |
|---|---|---|---|---|---|---|---|
| 2,711,666 | Ac-ft Water | 809,982 | 148,124 | 202,930 | 783,413 | 407,627 | 359,590 |
| 4.5 | Ac-ft/Acre | | | | | | |
| | **SCA-ALL** | **SCA-C1** | **SCA-C2** | **SCA-C3** | **SCA-C4** | **SCA-C5** | **SCA-C6** |
| Alfalfa | -0.195% | -0.184% | 0.022% | -0.021% | -0.132% | 0.067% | 0.052% |
| Barley | -0.323% | -0.323% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -0.462% | -0.309% | -0.153% | 0.000% | 0.000% | 0.000% | 0.000% |
| Bermudagrass | -0.212% | -0.147% | 0.000% | 0.000% | -0.074% | 0.000% | 0.009% |
| Broccoli | -0.125% | -0.053% | 0.000% | -0.012% | -0.030% | -0.023% | -0.007% |
| Carrots | -0.121% | -0.042% | 0.000% | 0.000% | -0.028% | -0.039% | -0.012% |
| Sweet Corn | -0.035% | -0.084% | 0.045% | 0.000% | 0.000% | 0.003% | 0.000% |
| Cotton | -3.743% | -0.502% | 0.000% | -2.341% | -0.900% | 0.000% | 0.000% |
| Lettuce | -0.082% | -0.039% | 0.000% | -0.009% | -0.011% | -0.021% | -0.002% |
| Melons | -0.123% | -0.103% | 0.009% | -0.020% | 0.000% | -0.009% | 0.000% |
| Oats | -2.333% | -2.333% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Onions | -0.038% | -0.009% | -0.001% | -0.002% | -0.013% | -0.008% | -0.006% |
| Potatoes | -0.032% | -0.033% | 0.002% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sudangrass | -10.500% | 0.000% | 0.000% | 0.000% | -5.869% | -1.848% | -2.783% |
| Sugarbeets | -0.171% | -0.046% | 0.000% | 0.000% | -0.142% | 0.004% | 0.013% |
| Wheat | -1.367% | -0.894% | 0.000% | -0.063% | -0.223% | -0.093% | -0.094% |
| Safflower | 19.868% | 5.107% | 0.075% | 2.467% | 7.421% | 1.968% | 2.830% |
| Total Acres | 0.009% | 0.006% | 0.000% | 0.000% | 0.000% | 0.001% | 0.001% |
| Acre-feet of Water | -5.213% | -1.048% | 0.000% | -1.748% | -1.877% | -0.221% | -0.318% |

Acres and Ac-feet values presented here represent the values used in the $40/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added.

## Table E.39 Acreage change in SCA Region from a $20/acre increase in profit from bermudagrass

**Change in acres from $20/acre increase in bermudagrass profit**

| 596,049 | Acres | 186,400 | 32,293 | 45,830 | 167,712 | 89,214 | 74,600 |
|---|---|---|---|---|---|---|---|
| | **SCA-ALL** | **SCA-C1** | **SCA-C2** | **SCA-C3** | **SCA-C4** | **SCA-C5** | **SCA-C6** |
| Alfalfa | (48) | (18) | 0 | 0 | 0 | 0 | (30) |
| Barley | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beans | (8) | (8) | 0 | 0 | 0 | 0 | 0 |
| Bermudagrass-interna | 2,307 | 710 | 0 | 0 | 630 | 0 | 966 |
| Broccoli | (3) | (1) | 0 | 0 | 0 | 0 | (1) |
| Carrots | (3) | (1) | 0 | 0 | 0 | 0 | (2) |
| Sweet Corn | (5) | (5) | 0 | 0 | 0 | 0 | 0 |
| Cotton | (866) | (29) | 0 | 0 | (837) | 0 | 0 |
| Lettuce | (1) | (1) | 0 | 0 | 0 | 0 | (0) |
| Melons | (4) | (4) | 0 | 0 | 0 | 0 | 0 |
| Oats | (2,517) | (2,517) | 0 | 0 | 0 | 0 | 0 |
| Onions | (1) | (0) | 0 | 0 | 0 | 0 | (0) |
| Potatoes | (1) | (1) | 0 | 0 | 0 | 0 | 0 |
| Sudangrass | (2,050) | 0 | 0 | 0 | 207 | 0 | (2,256) |
| Sugarbeets | (34) | (3) | 0 | 0 | 0 | 0 | (31) |
| Wheat | 1 | (1) | 0 | 0 | 0 | 0 | 3 |
| Bermudagrass-extern | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Acres | (3,233) | (1,880) | 0 | 0 | 0 | 0 | (1,353) |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $20/acre increase in bermudagrass profit**

| 596,049 | Acres | 186,400 | 32,293 | 45,830 | 167,712 | 89,214 | 74,600 |
|---|---|---|---|---|---|---|---|
| 2,853,014 | Ac-ft Water | 838,399 | 148,124 | 250,336 | 834,317 | 413,630 | 368,209 |
| 4.8 | Ac-ft/Acre | | | | | | |
| | **SCA-ALL** | **SCA-C1** | **SCA-C2** | **SCA-C3** | **SCA-C4** | **SCA-C5** | **SCA-C6** |
| Alfalfa | -0.008% | -0.003% | 0.000% | 0.000% | 0.000% | 0.000% | -0.005% |
| Barley | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -0.001% | -0.001% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Bermudagrass-interna | 0.387% | 0.119% | 0.000% | 0.000% | 0.106% | 0.000% | 0.162% |
| Broccoli | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Carrots | -0.001% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sweet Corn | -0.001% | -0.001% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Cotton | -0.145% | -0.005% | 0.000% | 0.000% | -0.140% | 0.000% | 0.000% |
| Lettuce | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Melons | -0.001% | -0.001% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Oats | -0.422% | -0.422% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Onions | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Potatoes | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sudangrass | -0.344% | 0.000% | 0.000% | 0.000% | 0.035% | 0.000% | -0.379% |
| Sugarbeets | -0.006% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.005% |
| Wheat | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Bermudagrass-extern | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Total Acres | -0.542% | -0.315% | 0.000% | 0.000% | 0.000% | 0.000% | -0.227% |
| Acre-feet of Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $20/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added.

## Table E.40 Acreage change in SCA Region from a $40/acre increase in profit from bermudagrass

**Change in acres from $40/acre increase in bermudagrass profit**

| Cluster share of region | | 31.2% | 5.5% | 7.4% | 28.4% | 15.1% | 12.4% |
|---|---|---|---|---|---|---|---|
| 590,483 | Acres | 184,372 | 32,293 | 43,770 | 167,712 | 89,214 | 73,122 |
| | **SCA-ALL** | **SCA-C1** | **SCA-C2** | **SCA-C3** | **SCA-C4** | **SCA-C5** | **SCA-C6** |
| Alfalfa | (397) | (18) | 0 | (349) | 0 | 0 | (30) |
| Barley | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beans | (8) | (8) | 0 | 0 | 0 | 0 | 0 |
| Bermudagrass-interna | 4,585 | 1,406 | 0 | 0 | 1,239 | 0 | 1,940 |
| Broccoli | (24) | (1) | 0 | (22) | 0 | 0 | (1) |
| Carrots | (3) | (1) | 0 | 0 | 0 | 0 | (2) |
| Sweet Corn | (5) | (5) | 0 | 0 | 0 | 0 | 0 |
| Cotton | (15,705) | (29) | 0 | (14,031) | (1,645) | 0 | 0 |
| Lettuce | (18) | (1) | 0 | (16) | 0 | 0 | (0) |
| Melons | (66) | (4) | 0 | (62) | 0 | 0 | 0 |
| Oats | (5,240) | (5,240) | 0 | 0 | 0 | 0 | 0 |
| Onions | (3) | (0) | 0 | (2) | 0 | 0 | (0) |
| Potatoes | (1) | (1) | 0 | 0 | 0 | 0 | 0 |
| Sudangrass | (4,303) | 0 | 0 | 0 | 407 | 0 | (4,709) |
| Sugarbeets | (34) | (3) | 0 | 0 | 0 | 0 | (31) |
| Wheat | (30) | (1) | 0 | (31) | 0 | 0 | 3 |
| Bermudagrass-extern | 12,453 | 0 | 0 | 12,453 | 0 | 0 | 0 |
| Total Acres | (8,799) | (3,908) | 0 | (2,060) | 0 | 0 | (2,831) |
| Acre-feet of Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Percent regional change in cluster acreage from $40/acre increase in bermudagrass profit**

| 590,483 | Acres | 184,372 | 32,293 | 43,770 | 167,712 | 89,214 | 73,122 |
|---|---|---|---|---|---|---|---|
| 2,853,014 | Ac-ft Water | 838,399 | 148,124 | 250,336 | 834,317 | 413,630 | 368,209 |
| 4.8 | Ac-ft/Acre | | | | | | |
| | **SCA-ALL** | **SCA-C1** | **SCA-C2** | **SCA-C3** | **SCA-C4** | **SCA-C5** | **SCA-C6** |
| Alfalfa | -0.067% | -0.003% | 0.000% | -0.059% | 0.000% | 0.000% | -0.005% |
| Barley | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Beans | -0.001% | -0.001% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Bermudagrass-interna | 0.776% | 0.238% | 0.000% | 0.000% | 0.210% | 0.000% | 0.329% |
| Broccoli | -0.004% | 0.000% | 0.000% | -0.004% | 0.000% | 0.000% | 0.000% |
| Carrots | -0.001% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sweet Corn | -0.001% | -0.001% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Cotton | -2.660% | -0.005% | 0.000% | -2.376% | -0.279% | 0.000% | 0.000% |
| Lettuce | -0.003% | 0.000% | 0.000% | -0.003% | 0.000% | 0.000% | 0.000% |
| Melons | -0.011% | -0.001% | 0.000% | -0.011% | 0.000% | 0.000% | 0.000% |
| Oats | -0.887% | -0.887% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Onions | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Potatoes | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Sudangrass | -0.729% | 0.000% | 0.000% | 0.000% | 0.069% | 0.000% | -0.798% |
| Sugarbeets | -0.006% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | -0.005% |
| Wheat | -0.005% | 0.000% | 0.000% | -0.005% | 0.000% | 0.000% | 0.000% |
| Bermudagrass-extern | 2.109% | 0.000% | 0.000% | 2.109% | 0.000% | 0.000% | 0.000% |
| Total Acres | -1.490% | -0.662% | 0.000% | -0.349% | 0.000% | 0.000% | -0.479% |
| Acre-feet of Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |

Acres and Ac-feet values presented here represent the values used in the $40/acre profit optimization.
Crops with acreage increases have been highlighted with the removal of vertical lines between columns.
The 'internal' and 'external' designation on energy crops refers to crops already in the rotation and those added.

**Table E.41 Acreage change in COA Region for $20/acre and $40/acre profits with safflower. The safflower production in Cluster 8 prompted a change in cropping activity in the COA Region. No other energy crops were adopted.**

**Change in acres from $20/acre increase in safflower profit**

| | COA-C1 | COA-C2 | COA-C3 | COA-C4 | COA-C5 | COA-C6 | COA-C7 | COA-C8 | COA-C9 | COA-C10 | COA-C11 | COA-C12 | COA-C13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alfalfa | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Barley | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beans | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Broccoli | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Carrots | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Corn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Forage Grasses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (299) | 0 | 0 | 0 | 0 | 0 |
| Garlic | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lettuce | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Melons | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oats | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Onion | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potato | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Safflower | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 206 | 0 | 0 | 0 | 0 | 0 |
| Tomato | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wheat | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Acres | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (93) | 0 | 0 | 0 | 0 | 0 |

**Change in acres from $40/acre increase in safflower profit**

| acres | 148,988 | 8,463 | 40,290 | 10,947 | 10,320 | 25,053 | 4,535 | 12,329 | 29,107 | 24,115 | 9,549 | 43,076 | 28,848 | 395,620 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| acre-feet | 224,468 | 26,022 | 71,346 | 40,198 | 26,914 | 55,368 | 12,066 | 26,322 | 61,522 | 65,454 | 24,694 | 79,886 | 80,984 | 795,244 |
| Acre-feet/acre | 1.5 | 3.1 | 1.8 | 3.7 | 2.6 | 2.2 | 2.7 | 2.1 | 2.1 | 2.7 | 2.6 | 1.9 | 2.8 | 2.0 |
| | **COA-C1** | **COA-C2** | **COA-C3** | **COA-C4** | **COA-C5** | **COA-C6** | **COA-C7** | **COA-C8** | **COA-C9** | **COA-C10** | **COA-C11** | **COA-C12** | **COA-C13** | **COA-ALL** |
| Alfalfa | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Barley | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beans | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Broccoli | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Carrots | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Corn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Forage Grasses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (572) | 0 | 0 | 0 | 0 | 0 | (572) |
| Garlic | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lettuce | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Melons | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oats | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Onion | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potato | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Safflower | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 393 | 0 | 0 | 0 | 0 | 0 | 393 |
| Tomato | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wheat | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Acres | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (178) | 0 | 0 | 0 | 0 | 0 | (178) |